FINAL

REMEDIAL INVESTIGATION REPORT
VOLUME 2 OF 2
APPENDICES

ECC SITE

ZIONSVILLE SITE

WA18.5L30.0

March 14, 1986

GLT424/135-1

CONTENTS

GLT90/75

MEMORANDUM

TO: File

FROM: Dennis E. Totzke/CH2M HILL/GLO

DATE: May 20, 1985

SUBJECT: ECC Remedial Investigation
Hydrogeologic Investigation
Subtask 3-1

JOB NO: W65230.C3

INTRODUCTION

This document is a Hydrogeologic Study technical memorandum (TM) for the Environmental Chemical and Conservation Corporation (ECC) site near Zionsville, Indiana. This work was performed in partial satisfaction of Contract No. 68-01-6692, Work Assignment No. 18.5L70.0, Task 3-1 of the Remedial Investigation authorized by the U.S. EPA. The primary purpose of the TM is to provide documentation of data obtained during the drilling and installation of groundwater monitoring wells.

PROBLEM STATEMENT

Environmental Chemical and Conservation Corp. operated as a solvent processing and reclaiming facility from 1977 until May 1980. During this period, approximately 350 generators disposed of such wastes as resins, paint sludges, waste oils and flammable solvents onsite in 55-gallon drums or by bulk discharge to onsite storage tanks. Some of the solvent wastes were processed and recovered. The site was closed down in early 1982 with an outstanding waste inventory of over 25,000 drums of liquid and solid wastes, and about 300,000 gallons of bulk storage liquids.

On March 17, 1981, the Indiana State Board of Health (ISBH) sampled two wells at the ECC site: MW-2A and MW-1B (Figure 1). The analysis of the sample from the shallow well, MW-1B, indicated the presence of several organic compounds. The organic contaminants found in the sample were:

methylene chloride	5.7 mg/L
1,1-dichloroethane	950 mg/L
trichlorethylene	10 mg/L

On November 29, 1982, the ISBH sampled five groundwater monitoring wells in the vicinity of the Northside Sanitary Landfill and ECC. Organic compounds, including 1.1-dichloroethane, Trans-1,2-dichlorethylene and methyl ethyl ketone were present in four of the five samples.

SCOPE

A hydrogeologic investigation was conducted to define the soil stratigraphy, characterize aquifers and determine groundwater flow directions, gradients, and seasonal water level variations in the vicinity of the ECC site and to define pathways of subsurface contaminant migration. Prior to collecting any additional data, existing information was reviewed. This included a search of historical aerial photographs, domestic and industrial well logs, relevant literature, and previous soil boring and monitoring well information from the ECC site and the Northside Sanitary Landfill. A subsurface exploration program was then performed to further define conditions at the site. The program included an electrical resistivity survey, test drilling with soil sampling, rock coring and installation of monitoring wells.

GEOLOGIC SETTING

Boone County, Indiana, is in a physiographic unit known as the Tipton Till Plain, a nearly flat to gently rolling glacial plain, which is the result of continental ice sheets that covered the county about 20,000 years ago. During the period, known as the Pleistocene Epoch, large quantities of earth materials were deposited upon the bedrock surface, with a maximum thickness approaching 350 feet. The major aquifers in Boone County are in sand and gravel deposits of glacial origin. These deposits are also important sources of aggregate materials.

The bedrock formations beneath the glacial drift in Boone County consist of limestones and dolomites of Silurian and Devonian age and shales of Devonian and Mississippian age. The beds generally dip about 10 to 30 feet per mile to the southwest toward the Illinois Basin. In general, the Silurian and Devonian age formations produce small to moderate amounts of water, while the Devonian and Mississippian age shales are not usually good water producers.

SUBSURFACE EXPLORATION PROGRAM

The initial subsurface exploration program was conducted between May and September 1983. It involved an electrical resistivity survey performed by Gilkeson and Heigold of Champaign, Illinois, and a test drilling and monitoring well installation program performed by Mateco Drilling Co. of Grand Rapids, Michigan, and ATEC, Inc., of Indianapolis, Indiana, and directed by CH2M HILL. An additional subsurface exploration program was conducted in October and November 1984. This program included installation of four additional monitoring wells by ATEC, Inc., under the direction of CH2M HILL.

ELECTRICAL RESISTIVITY SURVEY

An electrical resistivity survey was conducted to investigate the presence and lateral continuity of shallow sand and gravel deposits and the presence of fine-grained glacial tills in the vicinity of the ECC site. A secondary objective was to investigate the presence of a groundwater contaminant plume; however, baseline resistivity values were not available and measured resistivities could not be related to the presence of contaminants. The resistivity survey was useful in defining layer characteristics of geologic materials to depths greater than 100 feet. A report on the earth resistivity investigation is presented in Appendix A.

TEST DRILLING

A series of monitoring well clusters were installed around the ECC site. The wells were classified into three groups based on their relative borehole depths. Shallow boreholes (wells) were drilled to a maximum depth of about 30 feet. Intermediate boreholes (wells) were drilled to approximately 100 feet. Deep boreholes (wells) were drilled into the top of rock, approximately 155 to 165 feet. Borehole locations are shown in Figure 1. Wells were located outside of the hazardous waste site, except ECC-8A, and continuous monitoring with an HNU analyzer during drilling detected no readings above background.

Boreholes were advanced through the soil using hollow-stem-augers and/or rotary drilling techniques. The drilling fluid was clear water obtained from the City of Zionsville water supply and, in some cases, bentonite mud was used to complete deep boreholes. On deep and intermediate boreholes,

Appendix A
TECHNICAL MEMORANDUMS

HYDROGEOLOGIC STUDY
TECHNICAL MEMORANDUM

ECC SITE
ZIONSVILLE, INDIANA

EPA 18.5L30.0
W65230.C3

MAY 20, 1985

TECHNICAL MEMORANDUM

CH2M HILL

TO: File

DATE: September 7, 1984

SUBJECT: ECC Site Remedial Investigation
Residential Well Sampling
Subtask 2-6

PROJECT: W65230.C3

INTRODUCTION

The final RAMP for the Environmental Chemical and Conservation Corporation (ECC) site in Zionsville, Indiana, recommended a residential well sampling and analysis program for residences in the immediate vicinity of the site. This program was to have been implemented as an initial remedial measure (IRM). It was later determined by U.S. EPA headquarters that residential well sampling could not be done as an IRM. At the request of the U.S. EPA's onscene coordinator (OSC), the residential well sampling program was incorporated into the Remedial Investigation (RI) as Subtask 2-6 of the Site Definition Activities phase.

The residential well sampling effort was performed on May 10, 1983. Sampling was performed by personnel from CH2M HILL. This work was performed in partial satisfaction of Contract No. 68-01-6692, Work Assignment No. 18.5L30.0.

PURPOSE

The purpose of the sampling effort was to determine if off-site migration of contaminants is affecting water quality in local water supply wells. Contamination of these wells would present a potential hazard to human health by direct contact and ingestion of contaminated groundwater.

SCOPE

The final scope of the residential well sampling effort at the ECC site included the following samples:

- Five residential well samples

- One residential well duplicate sample
- One field blank

RESIDENTIAL WELL SELECTION

The general well selection strategy was to select residential wells that would adequately characterize water quality in the shallow drinking water aquifer in the immediate vicinity of the site. Available hydrogeologic information, well construction details and well logs were reviewed prior to selection of the residential wells sampled during this effort. Final selection of wells to be sampled was made by CH2M HILL and reviewed by the U.S. EPA.

Figure 1 illustrates the sampling locations while Table 1 describes the sampling locations.

SAMPLING EFFORT

All wells were pumped for 20 to 30 minutes prior to sampling. Samples were collected at the faucet closest to the wellhead and upstream of any water conditioning devices (e.g., water softener, iron filter, etc.). Samples were collected by filling the sample bottles directly from the faucet.

Location RW005 was sampled in duplicate. Sample ECC-RW001-001 was a field blank. Distilled water for the field blank was obtained from the Indiana State Board of Health in Indianapolis.

Sample fractions for metals were preserved with nitric acid and fractions for cyanide were preserved with sodium hydroxide. Samples were packed according to U.S. EPA Contract Laboratory Program (CLP) protocol. Samples were shipped via Federal Express to the contract laboratories on the day of sampling. Samples for organic analysis were shipped to California Analytical Laboratories. Samples for Tasks 1 and 2 inorganics and Task 3 cyanide analyses were shipped to the University of Washington.

The assigned case number was 1691. A summary of sample tracking documentation appears in Table 2.

PERSONNEL

The sampling crew consisted of personnel from CH2M HILL. The sampling team leader was Gerald Bills. He was assisted by Tom Gilgenbach, Dennis Totzke, and Phil Smith.

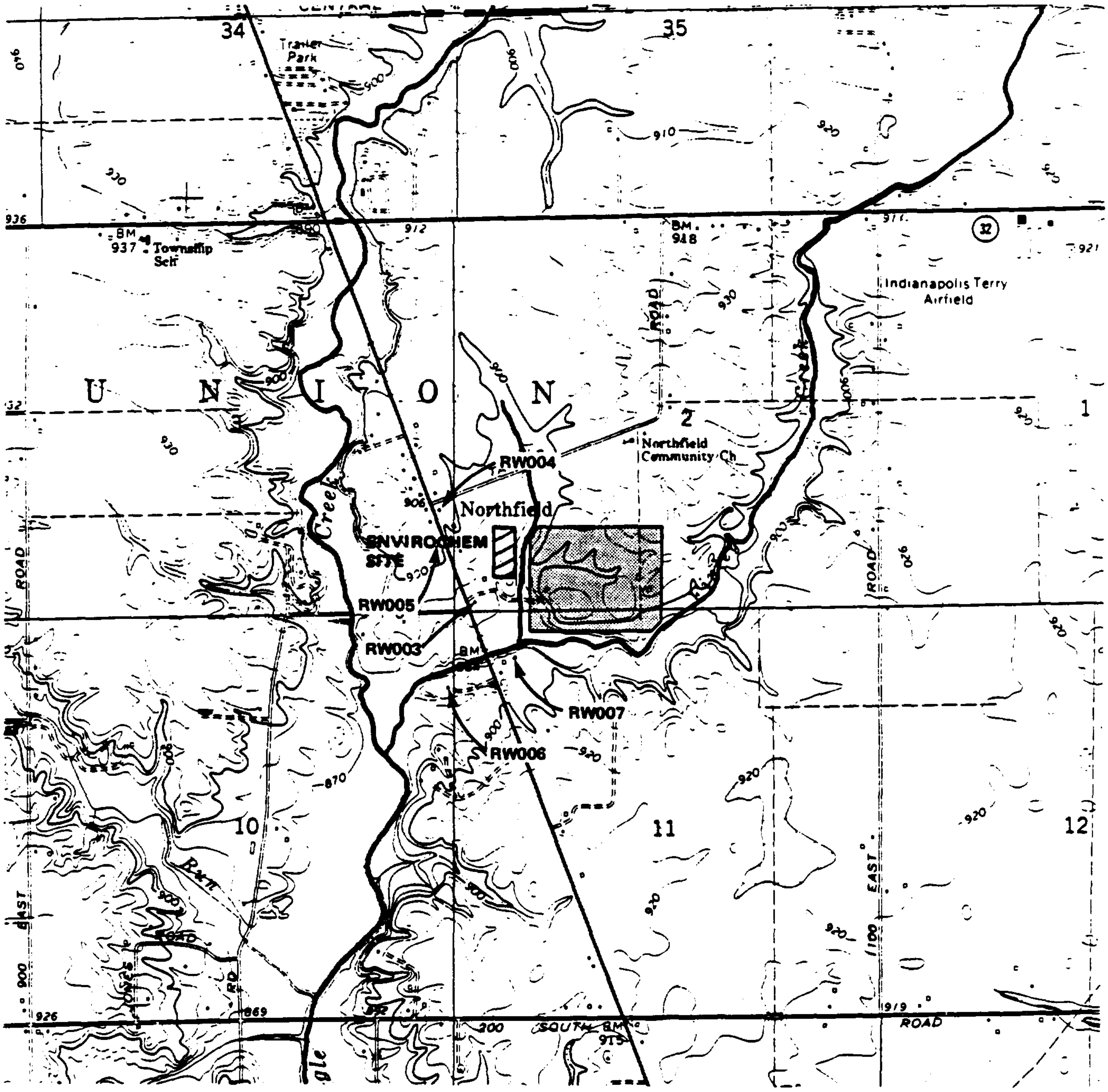


FIGURE 1
RESIDENTIAL WELL
SAMPLING LOCATIONS
ECC SITE

Table 1
RESIDENTIAL WELL SAMPLING LOCATIONS
RESIDENTIAL WELL SAMPLING
ECC SITE (SUBTASK 2-6)

Sample Number	Sample Location
ECC-RW001-001	Blank
ECC-RW003-001	John Bankert, Sr. 985 South S.R. 421 Zionsville, IN
ECC-RW004-001	David Roush 795 South S.R. 421 Zionsville, IN
ECC-RW005-001	Ira Jennings R.R. #1 Zionsville, IN
ECC-RW005-002	Ira Jennings R.R. #1 Zionsville, IN
ECC-RW006-003	George Holley 1120 South S.R. 421 Zionsville, IN
ECC-RW007-004	Robert Vandergriff 1115 South S.R. 421 Zionsville, IN

GLT412/28

Table 2
SAMPLE INDENTIFICATION MATRIX
RESIDENTIAL WELL SAMPLING
ECC SITE (SUBTASK 2-6)

CH2M HILL Sample Number	Date Sampled	Time of Collection	Date Shipped	Laboratory Service	Airbill Number	OTR	ITR	Chain-of-Custody
ECC-RW001-001	5/10/83	12:00 noon	5/10/83	California Analytical Labs	226490821	E2790		5-3173
				University of Washington	226490832		ME0627	5-3174
ECC-RW003-001	5/10/83	11:00 a.m.	5/10/83	California Analytical Labs	226490821	E2792		5-3173
				University of Washington	226490832		ME0629	5-3174
ECC-RW004-001	5/10/83	3:40 p.m.	5/10/83	California Analytical Labs	226490821	E2793		5-3173
				University of Washington	226490832		ME0630	5-3175
ECC-RW005-001	5/10/83	12:15 p.m.	5/10/83	California Analytical Labs	226490821	E2794		5-3173
				University of Washington	226490832		ME0631	5-3175
ECC-RW005-002	5/10/83	12:15 p.m.	5/10/83	California Analytical Labs	226490821	E2795		5-3173
				University of Washington	226490832		ME0032	5-3176
ECC-RW006-003	5/10/83	1:20 p.m.	5/10/83	California Analytical Labs	226490821	E2796		5-3173
				University of Washington	226490832		ME0633	5-3176
ECC-RW007-004	5/10/83	3:14 p.m.	5/10/83	California Analytical Labs	226490821	E2797		5-3173
				University of Washington	226490832		ME0634	5-3177

OTR = Organic Traffic Report
ITR = Inorganic Traffic Report

GLT412/26

ANALYTICAL RESULTS

Inorganic analytical results for the residential well samples are presented in Table 3. Quality assurance (QA) review of these data indicates that the boron analyses are unreliable due to contamination of the laboratory preparation blank. This blank also contained calcium, sodium, and aluminum within acceptable CLP limits. Iron and nickel concentrations were below the U.S. EPA contract detection limits, but above the laboratory's detection limits. Recoveries for spiked samples were above required limits for barium and silver and below the limits for calcium. The QA reviewer noted that high concentrations of aluminum may have interfered with determination of lead concentrations.

Organic analysis of well water samples failed to detect any of the compounds on the CLP list of hazardous substances. Table 4 lists the organic compounds that each sample was analyzed for. The methods used in the analysis did not identify any other organic compounds that may have been in the samples.

U.S. EPA QA review indicated that the organic data are not quantitatively valid. The acid and base/neutral data are qualitatively valid above the 50 ppb concentration level. The pesticide data are qualitatively valid above the 5 ppb level. The volatile compound data appear to be qualitatively valid above 20 ppb, based on the reported concentrations used in the calculation of the response factors for those compounds.

No effort has been made to interpret these results. Evaluation of the analytical data from residential well samples will be performed in Task 4 of the RI and discussed in the RI report.

GLT412/24

Table 3
INORGANIC ANALYTICAL RESULTS RESIDENTAL WELL SAMPLING
ECC SITE (SUBTASK 2-6)
CASE NO. 1691

Compound[a]	ME0629 Bankert Residence RW003	ME0630 Roush Residence RW004	ME0631 Jennings Residence RW005	ME0632 Jennings Residence RW005 (Duplicate)	ME0633 Holly Residence RW006	ME0634 Vandergriff Residence RW007	ME0627 Blank
Aluminum[e]	482[b]	447[b]	36[b,c]	131[b]	97[b,c]	498[b]	406[b]
Chromium	<DL	<DL	3.6[c]	<DL	<DL	<DL	4.5[c]
Barium[e]	9[c]	5.5[c]	303	<DL	278	2.4[c]	<DL
Beryllium	<DL	<DL	>DL	<DL	<DL	<DL	
Cobalt	<DL	<DL	<DL	<DL	8.9[c]	10.3[c]	<DL
Copper	<DL	<DL	42[c]	<DL	<DL	<DL	3[c]
Iron	14[c]	9.2[c]	3,290	11[c]	1,110	<DL	39[c]
Nickel	7[c]	11[c]	16	7.8[c,d]	19.3[c]	8[c]	<DL
Manganese[e]	<DL	<DL	133	<DL	33.9	<DL	<DL
Zinc	<DL	<DL	134	<DL	49.2	<DL	<DL
Boron[e,f]	2,220[b]	2,230[b]	580[b]	2,120[b]	990[b]	2,280[b]	1,870[b]
Vanadium	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Calcium[e]	325[b]	410[b]	103,000	348[b]	57,200	171[b]	40
Magnesium	220	480	40,900	245	26,200	290	<DL
Sodium[e]	381,000[b]	380,000	15,300[b]	353,000[b]	31,300[b]	260,000	143,000
Silver	<DL	<DL	<DL	<DL	7.7[c]	<DL	<DL
Arsenic	25	28	7[c]	23	7[c]	24	10
Antimony	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Selenium	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Thallium	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Mercury	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Tin	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Cadmium	<DL	<DL	<DL	<DL	<DL	<DL	<DL
Lead[g]	<DL	<DL	6.0	<DL	<DL	<DL	<DL
Cyanide	<DL	<DL	<DL	<DL	<DL	<DL	<DL

Note: Based on the QA review, the accuracy presented in this table may be suspect.

[a]All concentrations are expressed in ug/l.
[b]Concentration has been corrected for detected amount in the laboratory preparation blank.
[c]Value stated is below U.S. EPA contract detection limit.
[d]QA data indicates that relative percent differences (RDP's) were beyond acceptable QA limits.
[e]QA data indicate positive identification of these metals in the blanks or documented impurities.
[f]QA data indicate that boron analyses are invalid because of contamination in the preparation blank.
[g]QA data indicate that large concentrations of aluminum may have interfered with the lead analysis.
DL - Below analytical lab's detection limit.

GLT412/27

Table 4 (Page 1 of 4)
ORGANIC ANALYSIS LIST
ECC SITE

Constituent

ACID COMPOUNDS

2,4,6-trichlorophenol
p-chloro-m-cresol
2-chlorophenol
2,4-dichlorophenol
2,4-dimethyl phenol
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
4,6-dinitro-2-methy phenol
pentachlorophenol
phenol

BASE/NEUTRAL COMPOUNDS

acenaphthene
benzidine
1,2,4-trichlorobenzene
hexachlorobenzene
hexachloroethane
bis(2-chloroethyl)ether
2-chloronaphthalene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3'-dichlorobenzidine
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
fluoranthene
4-chlorophenyl phenyl ether
4-bromophenyl phenyl ether
bis(2-chloroisopropyl)ether
bis(2-chloroethoxy)methane
hexachlorobutadiene
hexachlorocyclopentadiene
isophorone
naphthalene
nitrobenzene
N-nitrosodiphenylamine

Constituent

BASE/NEUTRAL COMPOUNDS (continued)

N-nitrosodipropylamine
bis(2-ethylhexyl)phthalate
benzyl butyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate
diethyl phthalate
dimethyl phthalate
benzo(a)anthracene
benzo(a)pyrene
benzo(b)fluoranthene
benzo(k)fluoranthene
chrysene
acenaphthylene
anthracene
benzo(ghi)perylene
fluorene
phenanthrene
dibenzo(a,h)anthracene
indeno(2,3,3-cd)pyrene
pyrene

VOLATILES

acrolein
acrylonitrile
benzene
carbon tetrachloride
chlorobenzene
1,2-dichloroethane
1,1,1-trichloroethane
1,1-dichloroethane
1,1,2-trichloroethane
1,1,2,2-tetrachloroethane
chloroethane
2-chloroethylvinyl ether
chloroform
1,1-dichloroethene
trans-1,3-dichloropropene
cis-1,3-dichloropropene
ethylbenzene
methylene chloride

Constituent

VOLATILES (continued)

chloromethane
bromomethane
bromoform
bromodichloromethane
fluorotrichloromethane
dichloridifluoromethane
chlorodibromomethane
tetrachloroethene
toluene
trichloroethene
vinyl chloride

NONPRIORITY POLLUTANTS HAZARDOUS SUBSTANCES

benzoic acid
2-methylphenol
4-methylphenol
2,4,5-trichlorophenol
aniline
benzyl alcohol
4-chloroaniline
dibenzofuran
2-methylnaphthalene
2-nitroaniline
3-nitroaniline
4-nitroaniline
acetone
2-butanone
carbondisulfide
2-hexanone
4-methyl-2-pentanone
styrene
vinyl acetate
o-xylene

PESTICIDES[b]

aldrin
dieldrin
chlordane
4,4'-DDT
4,4'-DDE
4,4'-DDD

Constituent

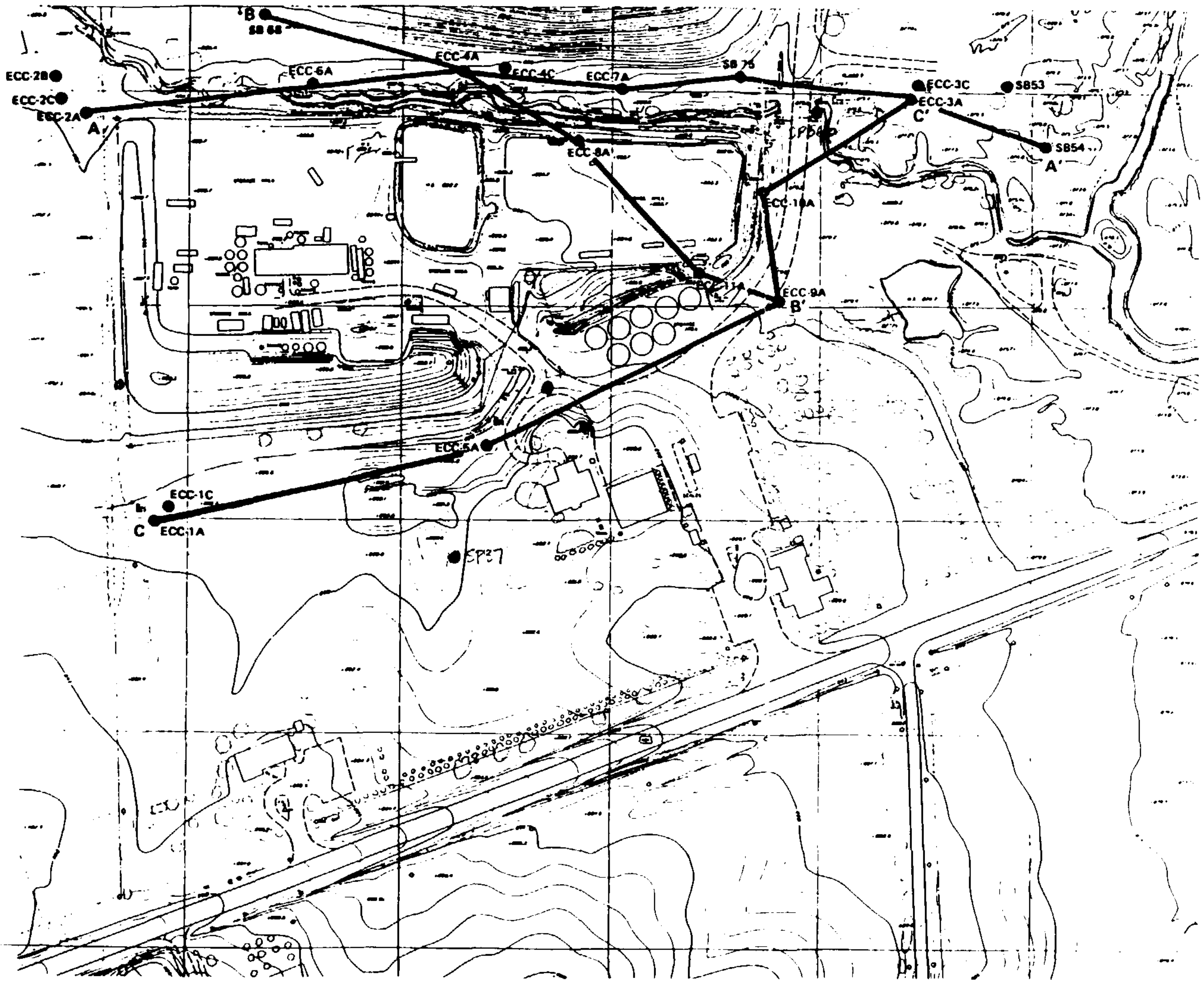
PESTICIDES (continued)

a-endosulfan
b-endosulfan
endosulfan sulfate
endrin
endrin aldehyde
heptachlor
heptachlor epoxide
a-BHC
b-BHC
d-BHC
g-BHC (lindane)
PCB-1242
PCB-1254
PCB-1221
PCB-1232
PCB-1248
PCB-1260
PCB-1016
toxaphene

DIOXINS

2,3,7,8-tetrachloro-dibenzo-p-dioxin

GLT412/29



LEGEND

ECC-7A REMEDIAL INVESTIGATION MONITORING WELL

MW2A MONITORING WELL INSTALLED BY ECC IN NOVEMBER 1975

ECC BOUNDARY FENCE

A —— A' CROSS SECTION LOCATION

NOTE: All well locations are approximate

N

0 50 100 150 200

SCALE IN FEET

FIGURE 1
MONITORING WELL LOCATIONS
ECC SITE
TM 3 1

6- or 4-inch diameter steel casing was used to seal off near-surface aquifers while drilling into deeper water-bearing zones. Continuous split-spoon samples were taken through the upper 20 to 30 feet in one borehole at each well cluster location to define the near-surface stratigraphy and determine the setting depth of the 6- or 4-inch temporary steel casing. Exact depths of drilling and casing are noted on the boring logs in Appendix B. Split-spoon samples were collected at 5-foot intervals below the 20- to 30-foot depth to the top of rock. One NX-size core run was advanced into rock at each deep borehole, except at borehole ECC-3C where the core barrel did not work properly.

MONITORING WELL INSTALLATION

Twelve monitoring wells were installed at seven locations around the ECC site (Figure 1). Shallow and deep wells were installed in the boreholes at the ECC-1, 3 and 4 cluster locations. Deep, shallow and intermediate wells were installed at the ECC-2 cluster location and single shallow wells were installed at ECC-5, 6, 7, 8, 9 10, and 11. Well construction drawings are presented in Appendix C.

Once a borehole was completed, it was cleaned of drill cuttings and fluid by flushing with City of Zionsville water. The monitoring well was then installed and developed. The development procedure at shallow wells used an air compressor to evacuate water from the standpipe above the screen. An airline was lowered down the well to a depth just above the top of the screen to ensure that no air was forced into the aquifer. The column of water in the standpipe was ejected, allowing aquifer water to surge into the well through the screen. Each well was surged until the purge water no longer contained sand or silt.

Well ECC-4A was contaminated with oil because the oil filter on the air compressor failed to work properly while developing the well. As a result, two additional wells, ECC-6A and ECC-7A, were installed along the eastern boundary of the ECC site. These two wells were developed using compressed nitrogen, rather than an air compressor, to prevent the possibility of oil contamination.

All of the deep wells and the one intermediate well were artesian, flowing at the ground surface after being completed. These were allowed to flow freely for approximately 10 to 12 hours and no other development procedure was used. The flowing wells were fitted with a special packer assembly that was lowered into the well on 1-1/4-inch PVC pipe, as shown in Appendix B. This system controls flow and allows water to be evacuated above the frost penetration zone for winter operation. Water level measurements can be taken by adding additional 1-1/4-inch diameter PVC standpipes above ground surface.

Ground surface elevations were surveyed and water levels were recorded at all wells except ECC 6A through 11A on June 29, 1983. Water levels were also measured with an electric sounder on either July 18, 19 or 20, 1983 and September 1, 1983; that were measured with an electric sounder. Elevations for ECC 6A through 11A were surveyed on December 13, 1984, when groundwater samples and water lime readings were taken. Water and ground surface elevations are listed in Table 1.

LABORATORY SOIL TESTING

Laboratory testing included index tests for soil identification and classification. These consisted of Atterberg limits, moisture contents and mechanical grain size analysis. Samples were selected for testing after visual classification of all samples from a borehole and were selected on the basis of being representative of soil types encountered. Laboratory test results are presented in Appendix D.

Mechanical grain size analysis is useful for determining the characteristics of coarse grained soils from a single borehole and for correlating stratigraphic units with similar grain size distributions from several boreholes. Grain size distributions of relatively well sorted and rounded sands and gravels can also be used to estimate soil hydraulic conductivities. Atterberg limits and moisture contents are conducted to determine the plasticity characteristics of silts and clays. This information is useful for cross borehole correlation and for making rough estimates of soil hydraulic conductivity without performing much more costly field and laboratory tests.

SUBSURFACE CONDITIONS

Soil types encountered from the ground surface to the top of rock are illustrated in Figure 2. These consist of glacial

Table 1 (Page 1 of 2)
GROUNDWATER LEVELS IN RI MONITORING WELLS
ECC SITE

Well No.	Ground Surface Elevation Ft. - MSL	Top Casing Elevation Ft. - MSL	Feet from Ground Surface[a]	Elevation Ft. - MSL	Date Recorded
ECC-1A	887.13	890.13	-5.46	881.67	6/29/83
			-5.67	881.46	7/19/83
			-6.24	880.89	9/1/83
			-5.45	881.68	11/29/83
			-4.58	882.55	12/12/84
ECC-1C	886.76	889.46	+5.06	891.82	6/29/83
			+4.70	891.46	7/18/83
			+3.99	890.75	11/29/83
			+2.50	889.26	12/13/84
ECC-2A	887.21	890.21	-5.15	882.06	6/29/83
			-5.43	881.78	7/19/83
			-6.15	881.06	9/1/83
			-5.31	881.90	11/29/83
			-4.50	882.71	12/12/84
ECC-2B	886.65	889.65	+5.19	891.84	6/29/83
			+4.34	890.99	7/20/83
			+3.78	890.43	11/29/83
			+2.10	888.75	12/13/84
ECC-2C	886.80	889.70	+5.09	891.89	6/29/83
			+4.78	891.58	7/18/83
			+3.78	890.67	11/29/83
			+2.29	889.09	12/13/84
ECC-3A	876.47	878.87	-4.31	872.16	6/29/83
			-5.13	871.34	7/19/83
			-4.90	871.57	9/1/83
			-5.26	871.21	11/29/83
			-3.91	872.56	12/12/84
ECC-3C	877.19	879.59	+12.52	889.71	6/29/83
			+12.24	889.43	7/20/83
			+13.30	890.49	11/30/83
ECC-4A	884.34	887.24	-4.11	880.23	6/29/83
			-4.38	879.96	7/19/83
			-4.66	879.68	9/1/83
			-3.51	880.83	12/12/84

Table 1 (Page 2 of 2)

Well No.	Ground Surface Elevation Ft. - MSL	Top Casing Elevation Ft. - MSL	Feet from Ground Surface[a]	Elevation Ft. - MSL	Date Recorded
ECC-4C	884.54	887.24	+7.71	892.25	6/29/83
			+6.93	891.47	7/18/83
			+6.10	890.64	11/30/83
			+4.65	889.19	12/13/84
ECC-5A	887.25	889.85	-6.10	881.15	6/29/83
			-6.49	880.76	7/19/83
			-6.92	880.33	9/1/83
			-6.19	881.06	11/30/83
			-5.39	881.86	12/12/84
ECC-6A	885.50	887.62	-4.45	881.05	9/2/83
			-3.59	881.91	11/30/83
			-3.12	882.50	12/12/84
ECC-7A	881.53	883.93	-8.50[b]	873.03[b]	9/1/83
			-2.43	879.10	11/30/83
			-2.61	878.92	12/12/84
ECC-8A	885.42	886.22	-3.27	882.15	12/12/84
ECC-9A	881.01	883.11	+0.08	881.09	12/12/84
ECC-10A	879.60	882.30	-5.71	873.89	12/12/84
ECC-11A	884.40	886.90	-3.43	880.97	12/12/84

[a]Positive sign indicates water level above ground surface; negative sign indicates water level below ground surface.

[b]Noted while drilling with hollow stem augers.

GLT360/50-2

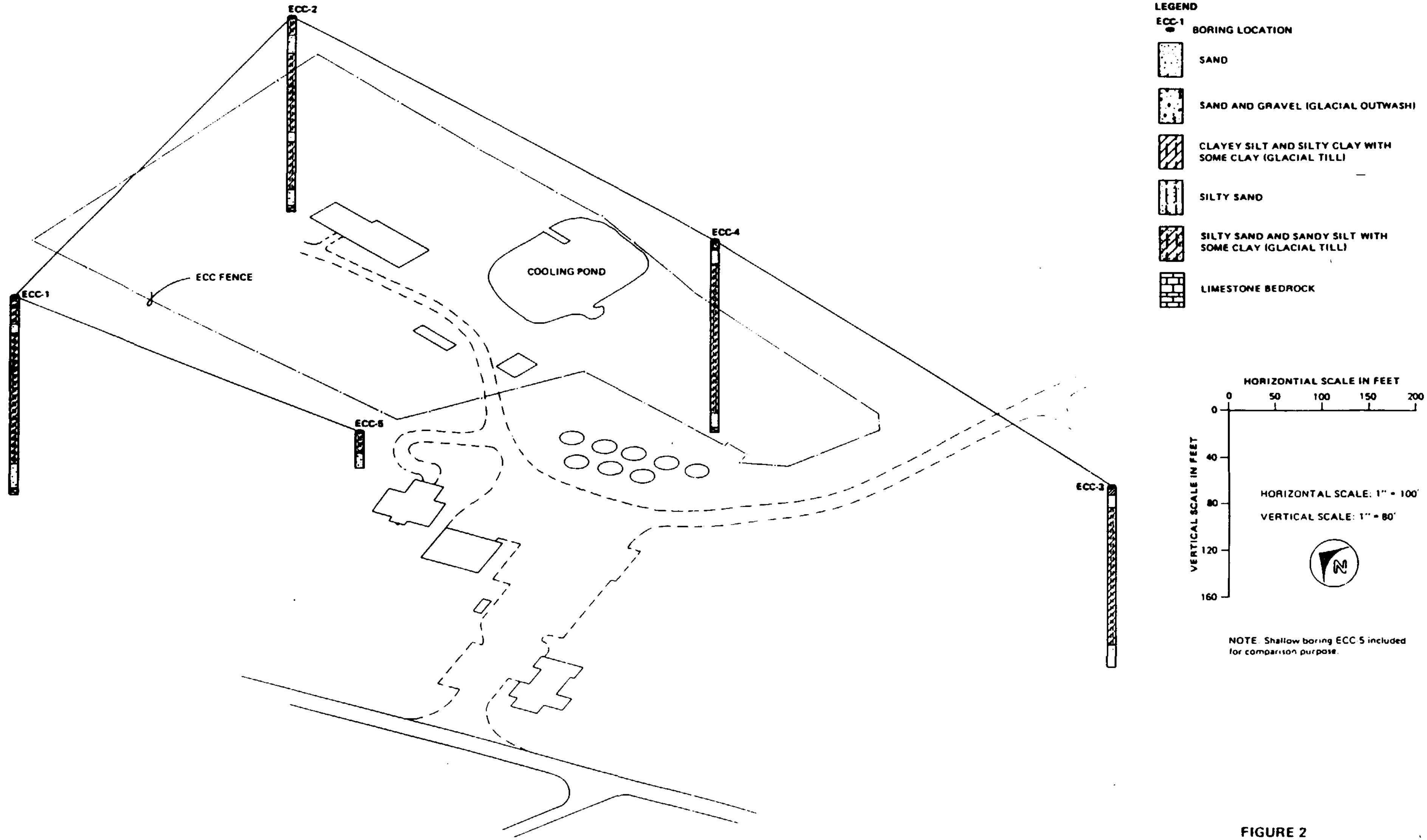


FIGURE 2
ISOMETRIC PROJECTIONS OF DEEP BORINGS
ECC SITE
TM 3-1

tills, glacial outwash and possibly some shallow alluvial deposits. The glacial till deposits, consisting predominantly of clayey silt and silty clay, formed the thickest sequence encountered. They appear to be highly overconsolidated based on Atterberg limits and relatively impermeable. Glacial outwash sands and gravels were found at all five boring locations. These consisted of fine to coarse sand and gravel that are highly permeable. Some alluvial deposits may occur near the ground surface, especially near the southeast corner of the ECC site and generally consist of fine sand and silty sand. Cross sections illustrating shallow soil conditions at the site are presented in Figures 3, 4, and 5. Included are some of the borings completed previously for the Northside Sanitary Landfill. The shallow soil stratigraphy appears to be very complex near the south end of the ECC site. This is probably due to the combination of till, outwash and alluvial deposits present in this area.

Three water-bearing zones occur at different elevations and appear to be fairly continuous under the site. These are:

- A silty clay zone, approximately 5 to 15 feet below ground surface
- A shallow sand and gravel zone, approximately 20 to 30 feet below ground surface
- A deep sand and gravel zone, approximately 150 to 165 feet below ground surface

The water table was identified while drilling with hollow-stem augers and continuous split-spoon sampling. Depths to the water table ranged from 6 feet at ECC-3 to approximately 10 feet at ECC-1, 4 and 5, to 15 feet at ECC-2. Approximate water table elevations are illustrated in Figure 6. The water table occurred in fine-grained soils, usually sandy silts or silty sand. At ECC-3, it occurred in a fine sand, relatively free of silt.

A shallow sand and gravel zone was identified between approximately the 20- and 30-foot depth at ECC-1, 2, 4, 5, 6, 8, 9, and 10. The potentiometric surface of this zone is at a higher elevation than the water table at these boring locations, as shown in Figure 6. This zone appears to be

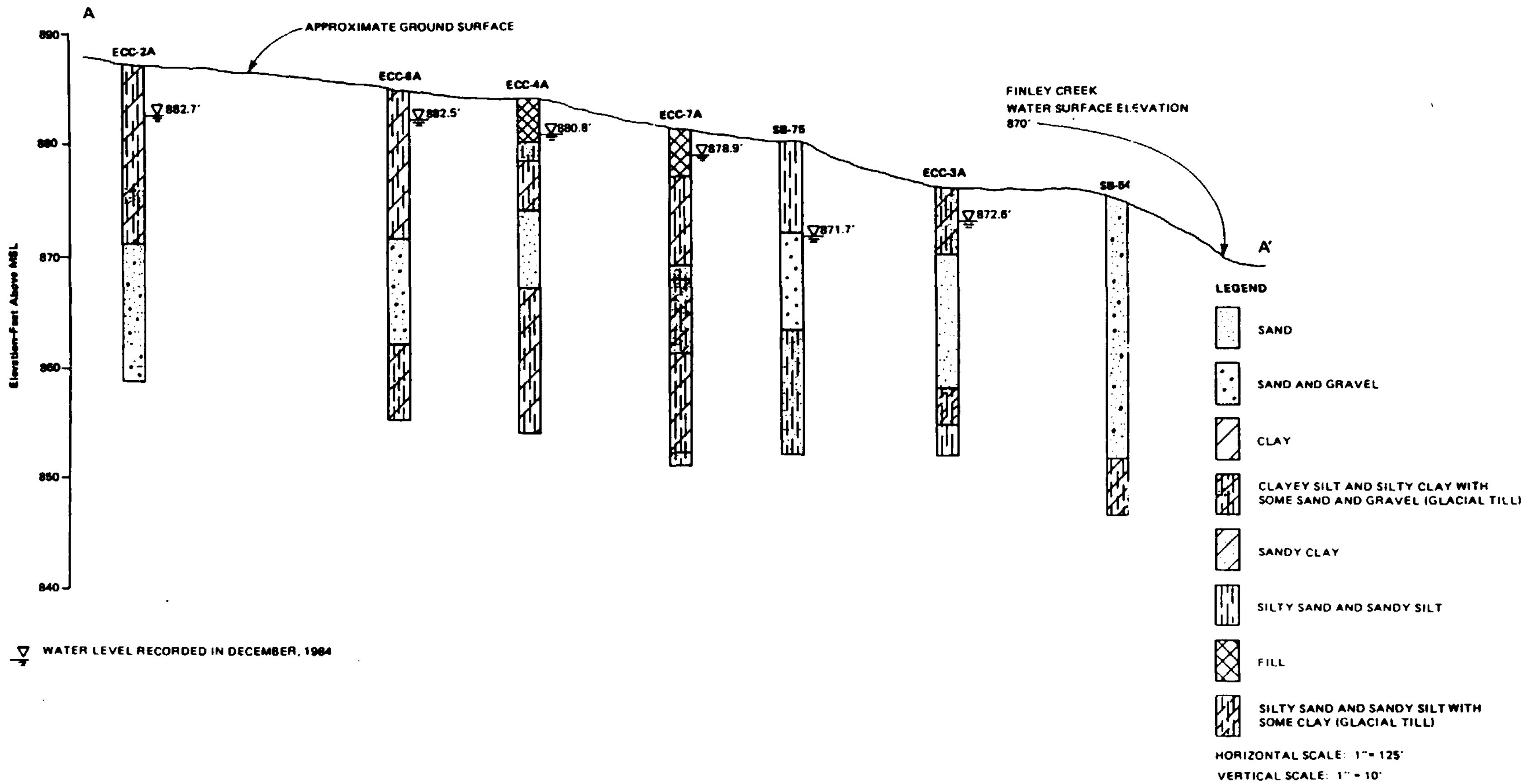


FIGURE 3
CROSS SECTION A-A'
ALONG THE UNNAMED DITCH
ECC SITE
TM 3 1

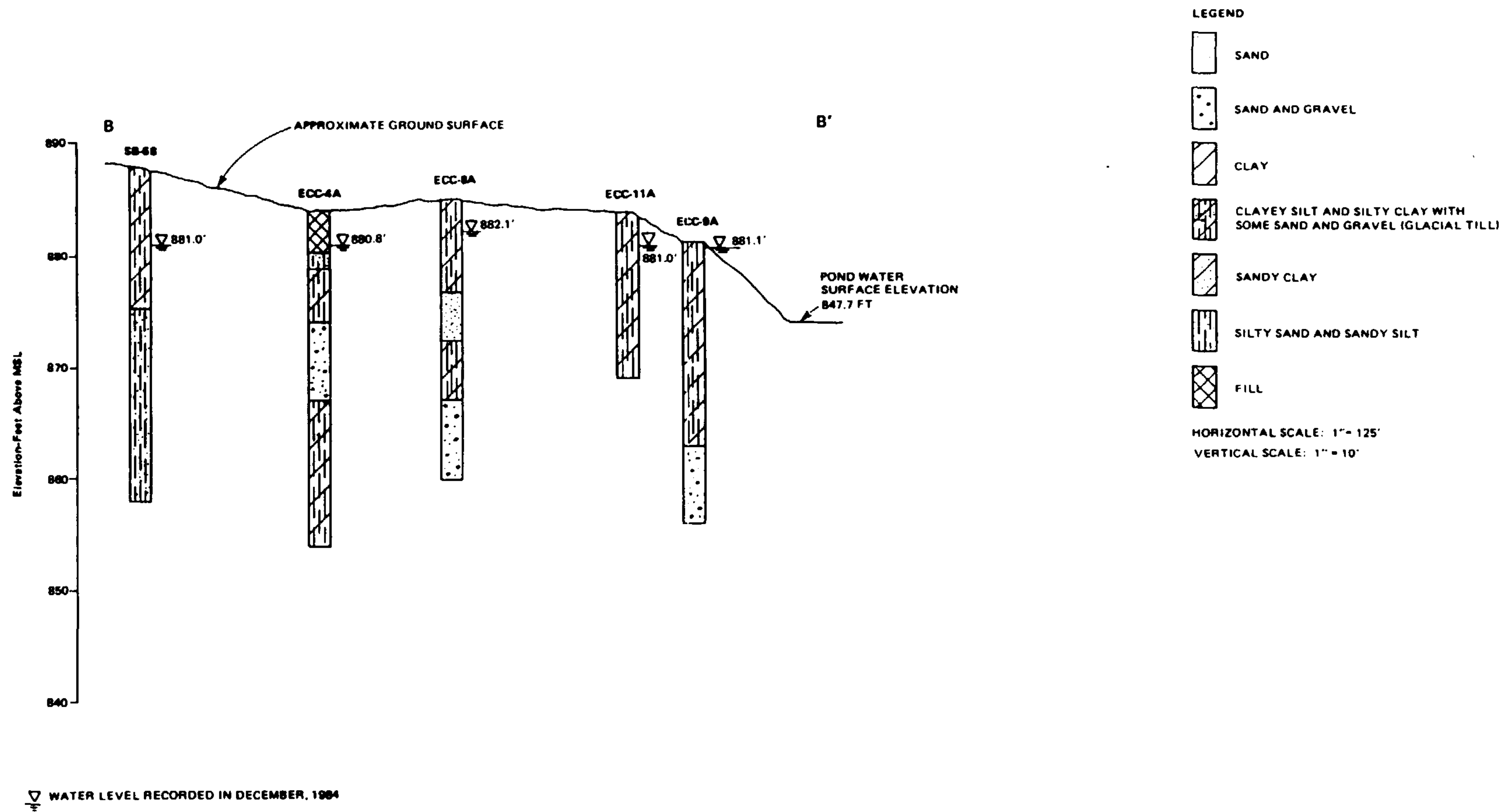


FIGURE 4
CROSS SECTION B-B'
NORTHEAST TO SOUTHWEST
ACROSS SITE
ECC SITE
TM 3-1

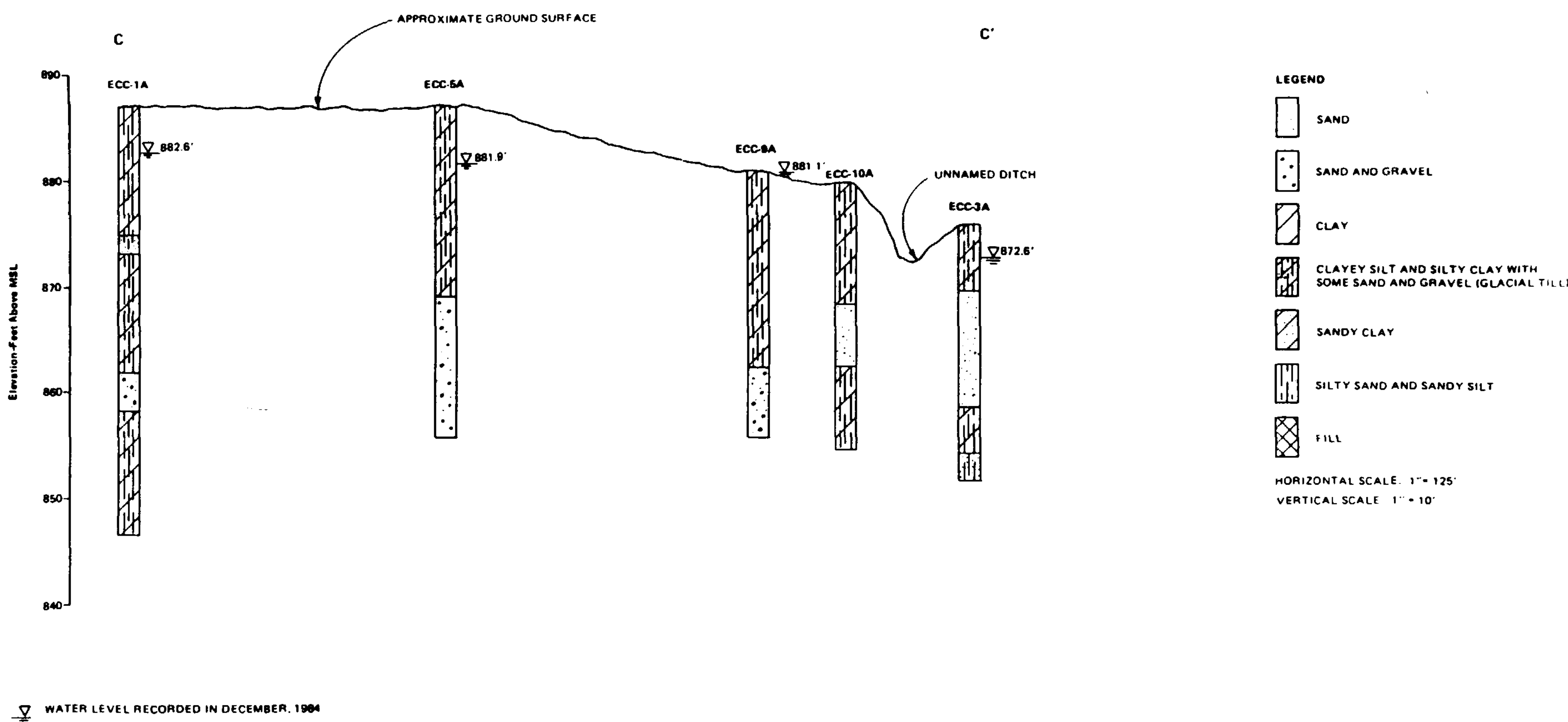
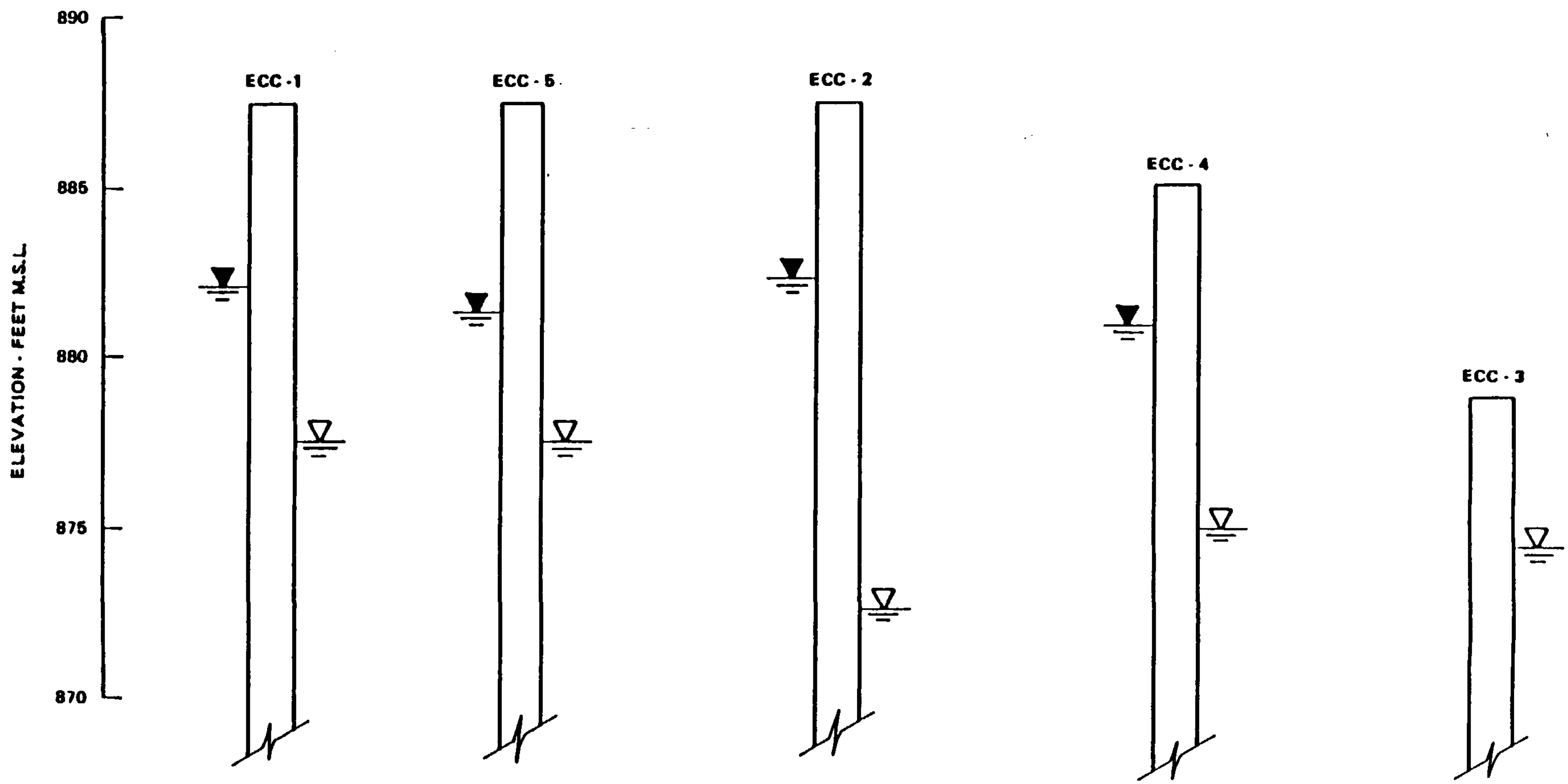


FIGURE 5
CROSS SECTION C-C'
NORTHWEST TO SOUTHEAST
ACROSS SITE
ECC SITE
TM 3-1



LEGEND

- WATER ELEVATION IN SHALLOW CONFINED AQUIFER AT THE COMPLETION OF WELL
- WATER TABLE ELEVATION NOTED WHILE DRILLING

NOTE: Shallow confined aquifer was not encountered at ECC - 3.

VERTICAL SCALE 1" = 5'

HORIZONTAL - NOT TO SCALE

FIGURE 6
HEAD DIFFERENCE BETWEEN WATER TABLE AND SHALLOW CONFINED AQUIFER
ECC SITE
TM 3-1

a glacial outwash sand and gravel zone, overlain by a silty clay till which in places my act as an aquitard. The upper till unit appears to be 10 to 15 feet thick throughout the northern half of the ECC site. At ECC-3, the shallow sand and gravel aquifer was overlain by 5 feet of till. The potentiometric surface of the sand and gravel zone at this well was not found to be appreciably different during drilling. The shallow sand and gravel zone at ECC-4 occurs at a higher elevation than at ECC-1, 2 and 5, and the zone consists of a finer, silty sand at ECC-4 than at the other boring locations. Due to the oil problem encountered when developing ECC-4A, two additional wells were added; ECC-6A and ECC-7A (Figure 1), along the unnamed ditch. An additional well was not added at the ECC-4 location because of the low permeability soils encountered there. The shallow sand and gravel zone was identified at the ECC-6 locations and has very similar characteristics to the 20- to 30-foot depth at ECC-1, 2 and 5. At ECC-7, the zone is similar to ECC-4, with large amounts of silt and interbedded clay lenses.

Four additional monitoring wells (8A, 9A, 10A, and 11A) were installed at the ECC site in October and November 1984. The locations were chosen to further assess groundwater flow and quality to the south and southwest of the site. Wells ECC-8A and -9A were installed in the shallow sand and gravel aquifer. Both wells were difficult to install because of flowing sand. Well ECC-9A was difficult to develop and does not produce a large quantity of water. This well should produce a large quantity, very quickly, based on the soil grains size characteristics and the drilling conditions. The reason this well does not produce water quickly, may be because the flowing sand caused silt and clay to cave in around the well screen, blocking the flow of water from the aquifer. Wells ECC-10A and -11A were installed in less permeable soil and also do not produce large quantities of water. Well ECC-10A was installed with a screened zone at about the same elevations as Wells 8A and 9A. Well ECC-11A was screened at a shallower zone, approximately 10 to 15 feet below ground surface, because of high HNU reading noted while drilling with the hollow stem augers.

The hydraulic conductivity was estimated, from grain size analysis, to be in the 10^{-3} to 10^{-2} cm/sec range.

A deep confined zone was found in outwash sands and gravels near the top of rock in all four deep borings (Figure 2). The potentiometric surface of this zone is above ground surface throughout the site, as shown in Table 1. This aquifer is confined by an extensive sequence of overlying till, which consists of very stiff to hard clayey silts and silty clays with very low relative permeabilities, based on Atterberg limits and visual classification. The natural moisture contents and Atterberg limits indicate that this till is highly overconsolidated. The maximum gradient in the deep confined aquifer was found to be 0.005 between wells ECC-3C and ECC-4C. The hydraulic conductivity was estimated, from grain size analysis, to be in the 10^{-4} to 10^{-3} cm/sec range.

Several other sandy zones in the till are possibly small outwash stages and may be water-bearing zones. Monitoring well ECC-2B is completed in such a zone, approximately 100 feet below ground surface. The water level in ECC-2B is very close to the water level in the deep well, ECC-2C (Table 1). This zone is about 10 feet thick; however, other zones encountered were usually less than 5 feet thick and generally contained considerable amounts of silt and clay.

CONCLUSIONS

Two sand and gravel zones were identified beneath the ECC site. The deep zone is confined and occurs at a depth of about 155 to 165 feet below ground surface and just above the top of rock surface. A shallow sand and gravel zone occurs at about 20 to 30 feet below ground surface and may be semiconfined in places due to lithologic variations in the upper saturated zone. A thick glacial till sequence of hard silty clay and clayey silt separates the two. The potentiometric surface of the deep zone was found to be above ground surface at all four deep boring locations. The potentiometric surface of the shallow aquifer was above the water table at all boring locations except ECC-3. Flow in both zones appears to be generally to the south, toward Finley Creek (Figure 7).

The water table or top of the zone of saturation in the near surface soil was identified while drilling with hollow stem augers. It occurred in fine grained soil, usually sandy silt or silty sand, except at the ECC-3 boring location, where it occurred in a clean fine sand.

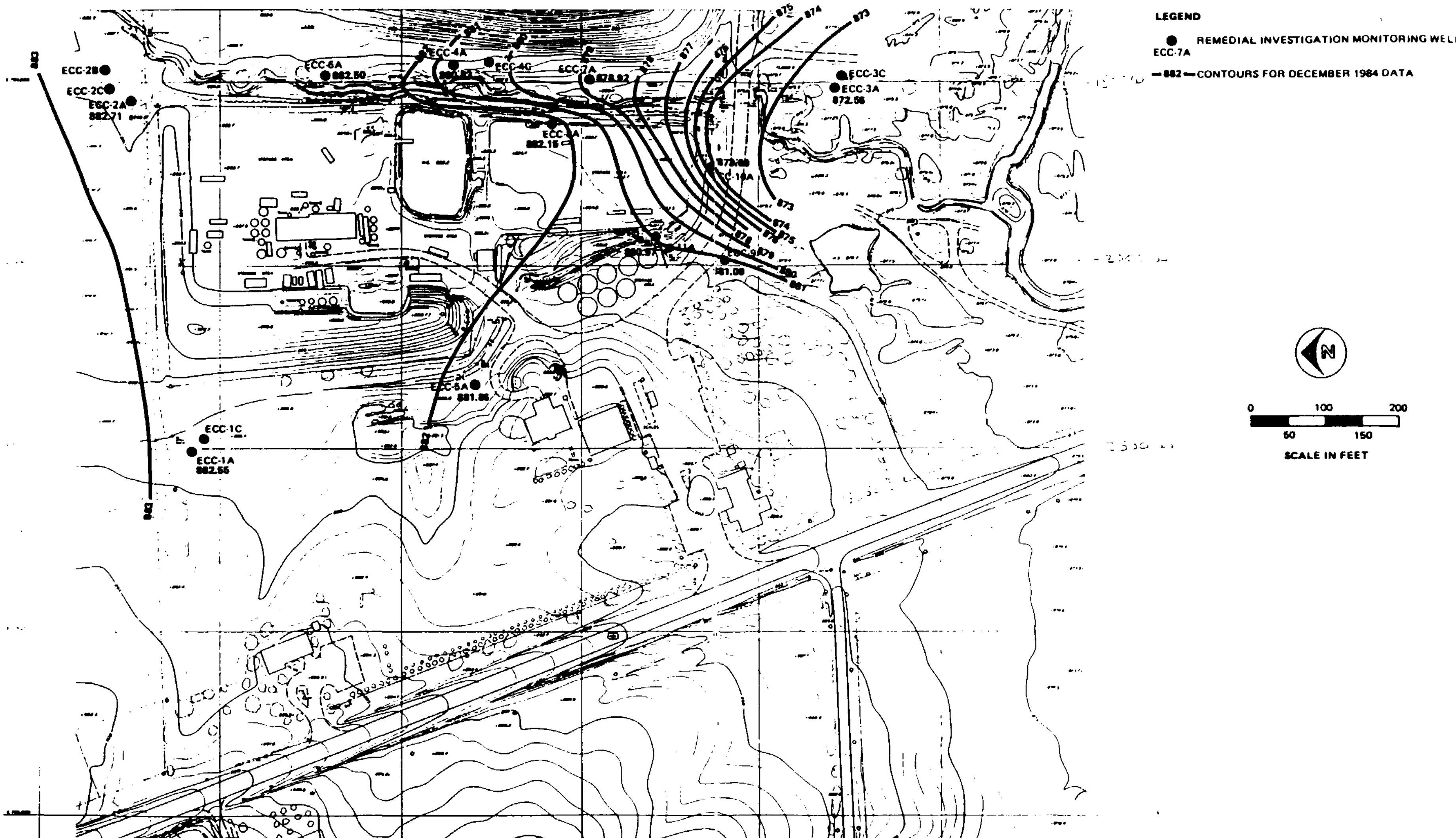


FIGURE 7
GROUNDWATER CONTOUR MAP
DECEMBER 1984
ECC SITE
TM 3-1

Possible groundwater contaminant sources at the ECC site include the cooling water pond, the surface storage areas and spill areas around the bulk tanks. Possible pathways of contamination appear to be in the water table aquifer and along the unnamed ditch, especially near the southeast corner of the ECC site where relatively permeable soils exist near ground surface. Contaminants may also be migrating in the shallow confined aquifer in the vicinity of the cooling water pond, which may be excavated to a depth below the top of this aquifer. Contamination of the deep confined aquifer is unlikely because of the thick sequence of low permeability soils that act as a confining layer and the very high potentiometric surface of the aquifer, which causes an upward gradient throughout the confining layer.

GLT90/54

TECHNICAL MEMORANDUM
Subtask 3-1

Appendix A
ELECTRICAL RESISTIVITY SURVEY

AN ELECTRICAL EARTH RESISTIVITY INVESTIGATION IN THE VICINITY OF THE ENVIRONMENTAL CONSERVATION AND CHEMICAL CORPORATION SITE

Robert H. Gilkeson and Paul C. Heigold

Introduction and Physical Setting

This report presents findings from the application of the surface electrical earth resistivity method to define shallow geologic materials in the vicinity of the Environmental Conservation and Chemical Corporation Site (ECC). The study area is shown on plate 1. The ECC Site is located adjacent to U.S. Route 421, approximately 10 miles north of the corporate boundary of Indianapolis in the eastern part of Boone County, Indiana. The physiographic setting of the area surrounding the site is the Tipton Till Plain, an extensive flat to gently rolling region formed on ground moraine till deposited during the Wisconsinan glacial advance.

The ECC Site is situated immediately adjacent to a large municipal refuse landfill. An unnamed stream flows southward along the east side of the site, between the site and the covered surface of the landfill. Final cover elevations on the top of the landfill are 994 feet above sea level. Excluding the elevations on the landfill, elevations over the rest of the study area vary from approximately 906 feet in the northwestern corner to less than 869 feet along Finley Creek in the southern part.

There are drainageways along the west, south and east sides of the ECC Site. The drainageways meet near the southeast corner of the site. At a distance of 400 feet south of the junction, the combined drainage discharges into Finley Creek.

The highest elevations on the ECC Site are in a bermed area along the northwestern and northern side of the site. Elevations along the top of the berm range from 896 feet to 900 feet above sea level. Elevations on the drum storage areas within the site range from approximately 883 feet to 887 feet above sea level. Surface water from a large part of the site drains into a cooling water lagoon that is present in the east-central part of the site.

Elevations in the floor of the drainageway along the east side of the site vary from 882 feet at the northeastern corner of the site to 875 feet at the junction of the two streams in the southeastern corner of the site. Elevations in the floor of the drainageway at the northwestern corner of the site are 886 feet above sea level.

The drainageways may be zones of discharge for groundwater in short flow-paths from the site. However, a component of recharge on the site may flow southward in the shallow geologic materials to zones of discharge along Finley Creek. The composition of the shallow geologic materials is an important control on the migration of contaminants away from the site. The texture and composition of the materials affect the velocity of groundwater and the attenuation of contaminants.

Drillers records from shallow borings in the study area have established the widespread presence of sand and gravel deposits in the shallow geologic materials. The borings also established that the sand and gravel was underlain by fine-grained glacial till. Four deep borings located in the vicinity of the ECC Site that were recently drilled to the bedrock surface found thick deposits of glacial till. Inter-till deposits of sand and gravel were present in some of the borings. These sand and gravel deposits are laterally discontinuous. The total thickness of unlithified materials at the boring sites varied from 155 feet to 166 feet. A basal zone of sand and gravel (thicknesses varying from 10 to 20 feet) was present in all four borings. At three sites, the sand and gravel was in open connection with the limestone bedrock—at one site an 8 foot thick layer of glacial till separated the sand and gravel from the bedrock. Bedrock surface elevations at the sites of the four borings range from 720.5 to 724.5 feet above sea level. Monitoring wells constructed in the deep sand and gravel deposits established that artesian conditions were present. The thick deposits of glacial till and the upward groundwater gradients in these materials are an important safeguard to prevent contamination of groundwater resources in the deep sand deposits and in the limestone bedrock.

A field investigation with the surface electrical earth resistivity method was conducted on the site to obtian information on the geologic materials. The geophysical investigation was designed to investigate the presence and lateral continuity of shallow deposits of sand and gravel and the presence of thick deposits of fine-grained glacial tills throughout the study area to depths greater than 100 feet.

Electrical Earth Resistivity Investigation

Background

The resistivity of a geologic material is a function of several variables such as matrix conduction, the size, quantity and inter-connectedness of pore spaces and the ionic strength of the contained fluid. It is obvious that the resistivity of geologic materials cannot be defined in terms of lithology alone; however, some generaliztions are possible:

1. Unsatuarated geologic materials have higher resistivity values than the same materials saturated.

2. Massive rocks with little pore space have high resistivities.

3. Saturated clayey sediments have low resistivities.

4. Clean sand and gravel deposits (little clay content) that are saturated with groundwater of low ionic strength will have high resistivities.

5. Geologic materials (including sand and gravel) that are saturated with groundwater of high ionic strength may have very low resistivities.

The significance of these generalizations to the geologic materials on the ECC Site are as follows:

1. Thick sand and gravel deposits should have a significantly higher resistivity than the fine-grained glacial tills.

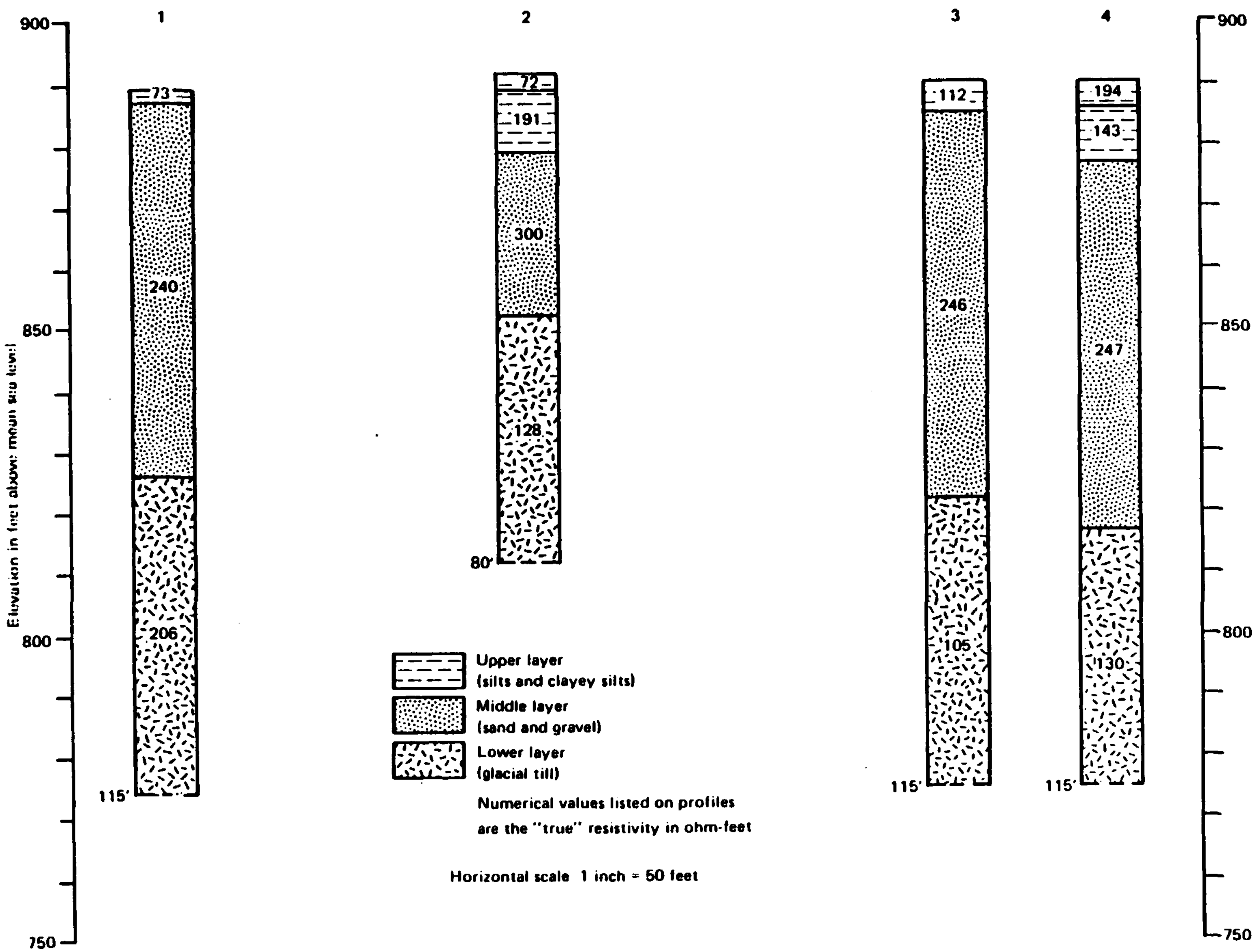


FIGURE 3. Strip records showing layering parameters for regional stations located north of the ECC-Site.

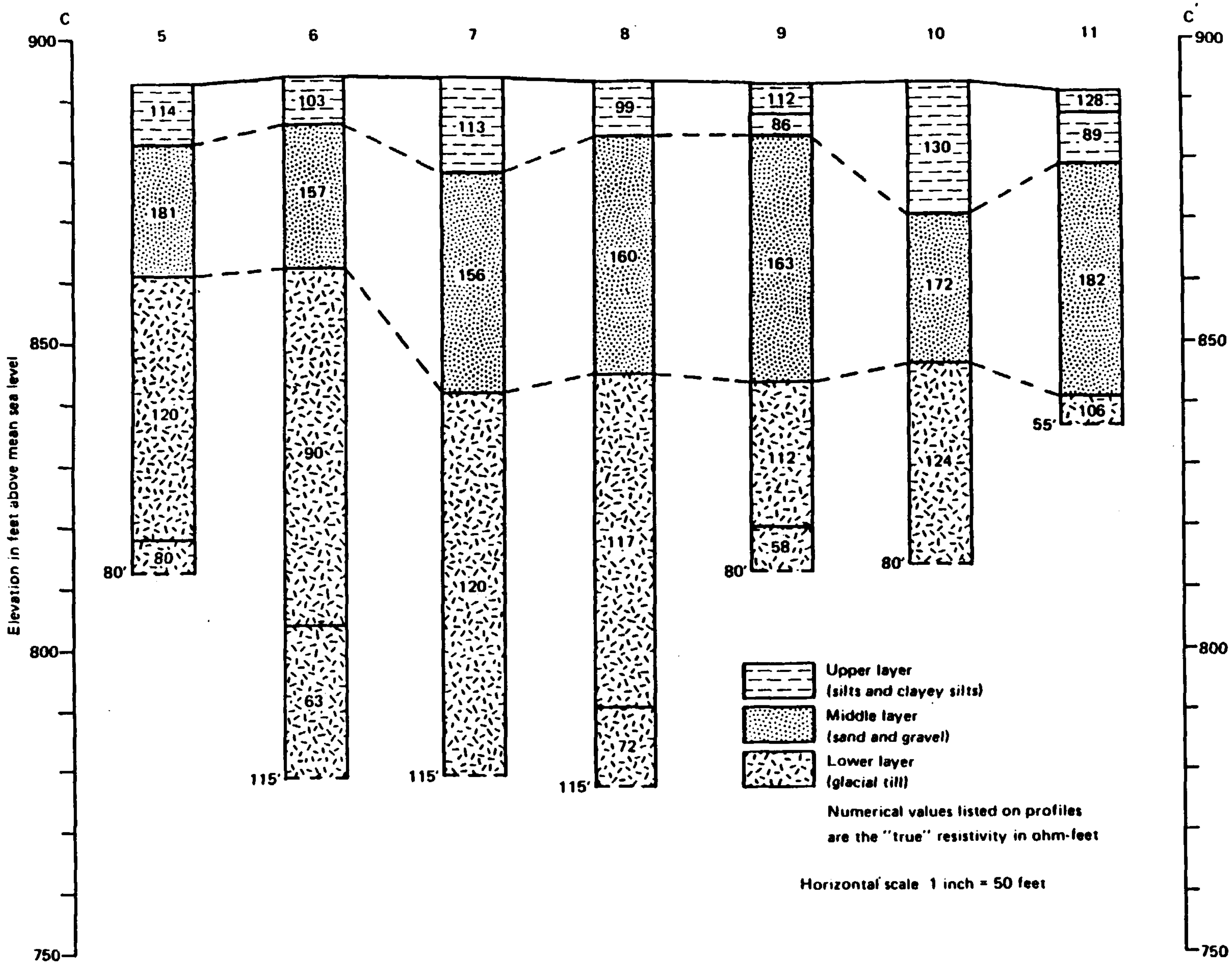


FIGURE 10. Geoelectric section for stations along traverse C-C' on the northern side of the ECC-Site. Stations were located 10 feet north of the site fence.

2. The resistivity of sand and gravel deposits near the ECC Site or the landfill may be lowered if they contain contaminanted groundwater of high ionic strength.

3. In some locations the surficial silty materials may be unsaturated and therefore have resistivities that are similar to values for sand and gravel.

4. The dense, massive limestone bedrock may have very high resistivity values.

Methods of Data Collection and Analysis

The geophysical field program was conducted on four separate dates—May 1, May 8, May 18, and May 22, 1983. The 52 stations where electrical earth resistivity measurements were taken are shown on plate 1. The study area contained many features that may interfere with surface electrical measurements (metal fences, metal buildings and tanks, buried and overhead electrical lines). Because of these features, a series of measurements were taken at each measurement station through a systematic expansion of the electrode array; a measurement technique known as vertical electrical sounding (VES). In the present study measurements were taken with a modified Schlumberger electrode array where a constant 10:1 ratio is maintained for the distance separating the current and potential electrodes. Apparent resistivities were calculated for all of the measurements and graphs (VES-profiles) were constructed for each station that showed the apparent resistivity values as a function of the distance of electrode separation. The graphs were then analyzed to reject erroneous values due to measurement error or interference. Representative VES-profiles for 4 stations are shown in figures 1 and 2. Current electrode spacings out to distances of 305 100 m feet were used at most stations. At several stations measurements were made at current electrode separations of 656 feet. Appendix I presents the apparent resistivity values measured at each current electrode separation distance for the 52 stations. A digital computer program by Zohdy (1973) was

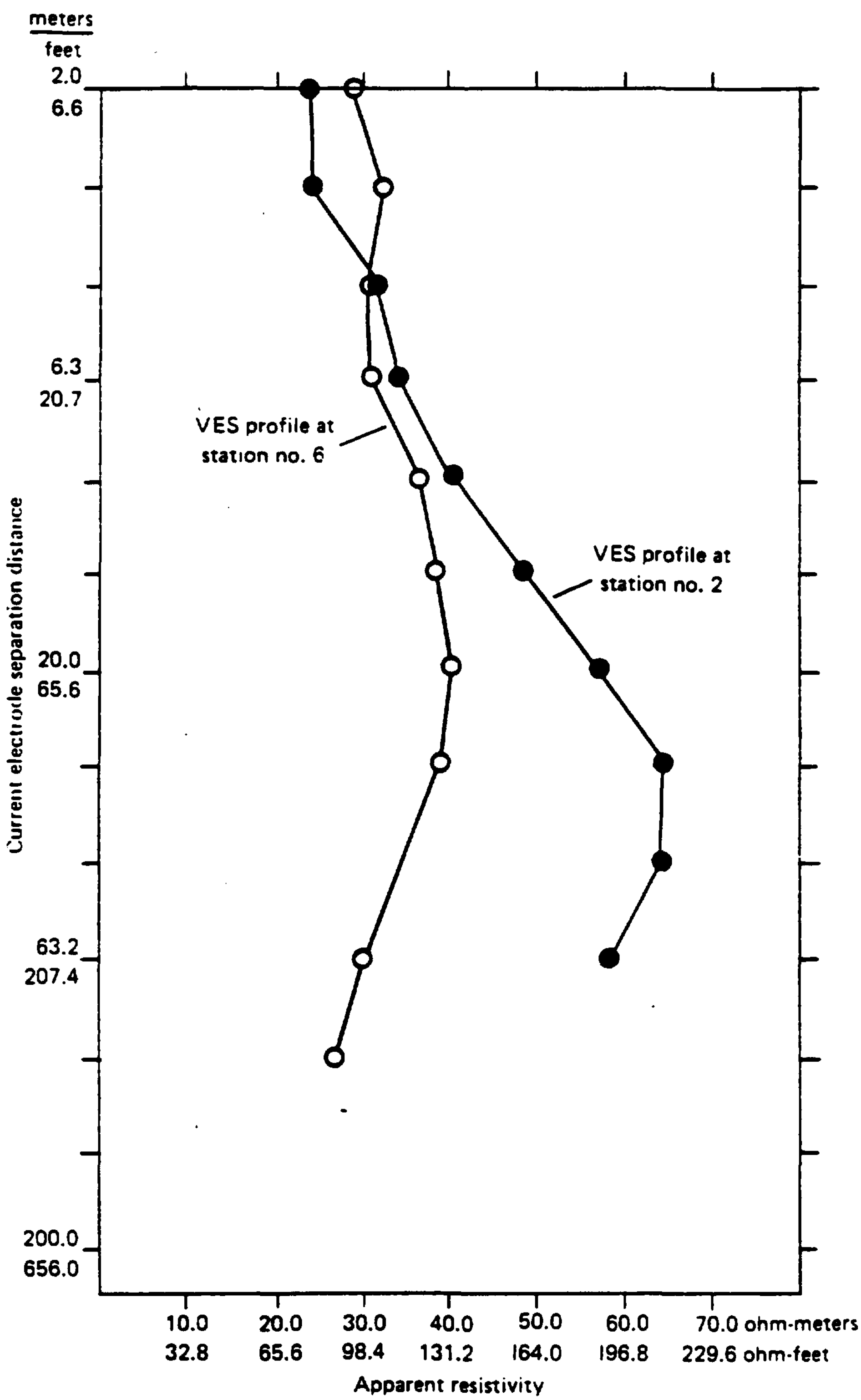


FIGURE 1. VES-profiles for station no. 6 and station no. 2 on the north side of the ECC-Site. VES-6 is located 10 feet north of the metal site fence. VES-2 is located 110 feet north of VES-6 in an open field.

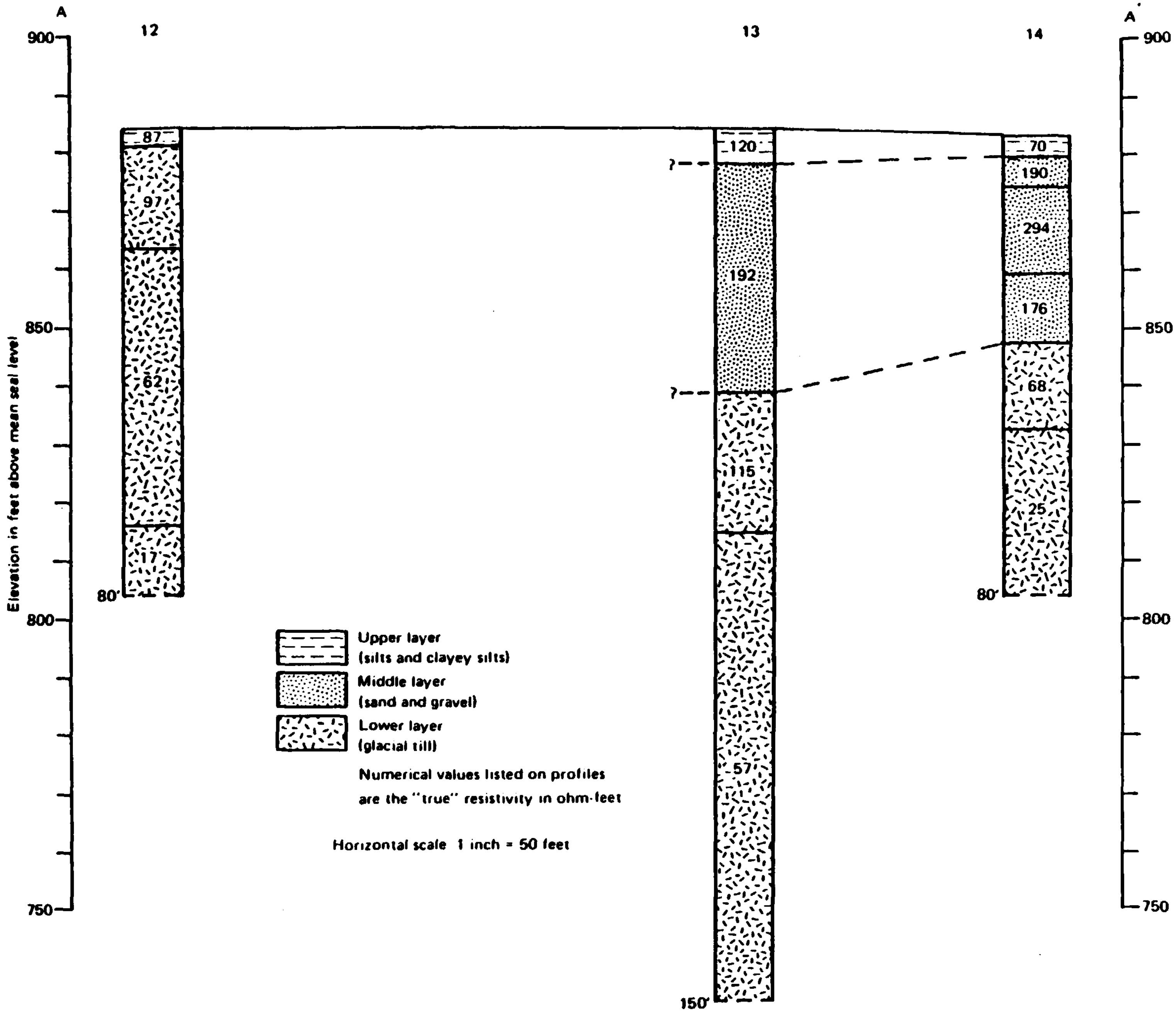


FIGURE 12. Geoelectric section for stations located east of the unnamed drainage-way on the east side of the ECC-Site near the west side of the landfill.

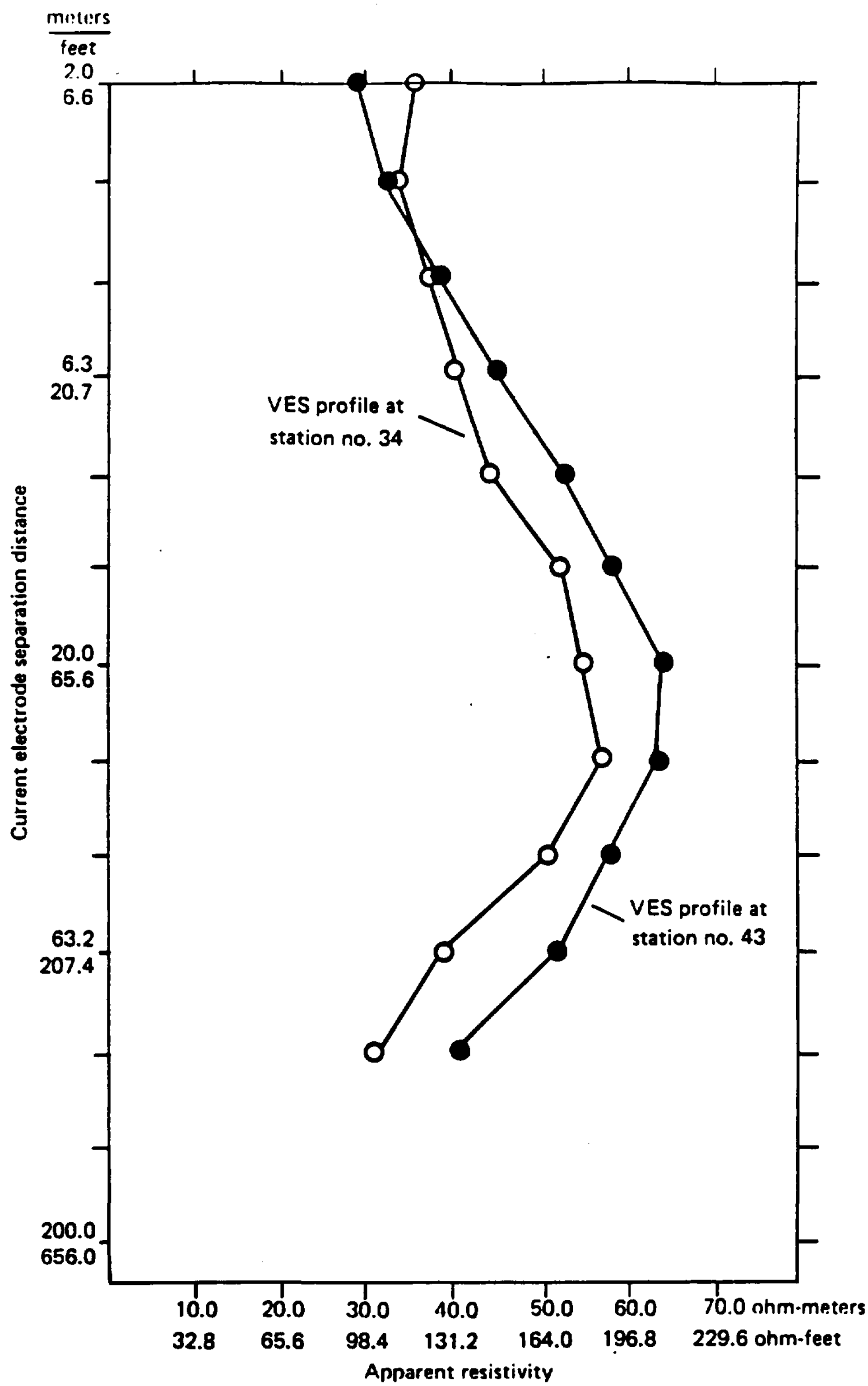


FIGURE 2. VES-profiles for station no. 34 and station no. 43 on the west side of the ECC-Site. VES-34 is located 25 feet west of the site fence. VES-43 is located 20 feet west of VES-34

used to solve the inversion problem to determine the layering parameters—"true" thickness and "true" resistivities of the geologic materials for each of the VES-profiles. The determined values are referred to as "true" in recognition that they are a best approximation of the real values. Figures 3 through 12 show the layering parameters for each VES station on strip records that include a lithologic interpretation. Most of the VES stations were located along 7 traverses shown on plate 1. Figures 5, 6, 8, 9, 10, 11 and 12 present geoelectric sections for each traverse.

The geophysical instruments used in the field program were a Bison Model no. 2350-B and an ABEM Terrameter Model no. SAS-300. The Terrameter instrument was used for all of the measurements on traverses B-B', C-C', D-D', E-E' and F-F'.

Results

The surface electrical earth resistivity measurements determined that the general sequence of geologic meaterials in the study area is a thin upper layer of low resistivity materials (interpreted to be silts and clayey silts), a middle layer of high resistivity materials (interpreted to be sand and gravel), and a thick lower layer of low resistivity materials (interpreted to be fine-grained glacial till). The middle high resistivity layer is present at all stations except for VES-12 located in the northeastern corner of the study area. The thick lower layer of low resistivity materials is present throughout the study area. Intertill deposits of sand and gravel were not detected at any of the stations. Borings have established that these deposits are present locally. These relatively thin, discontinuous deposits cannot be detected with surface electrical methods where they are interbedded in thick deposits of glacial till.

At a few stations, the electrical measurements at large electrode separation distances indicated a deep layer of high resistivity materials (the limestone bedrock).

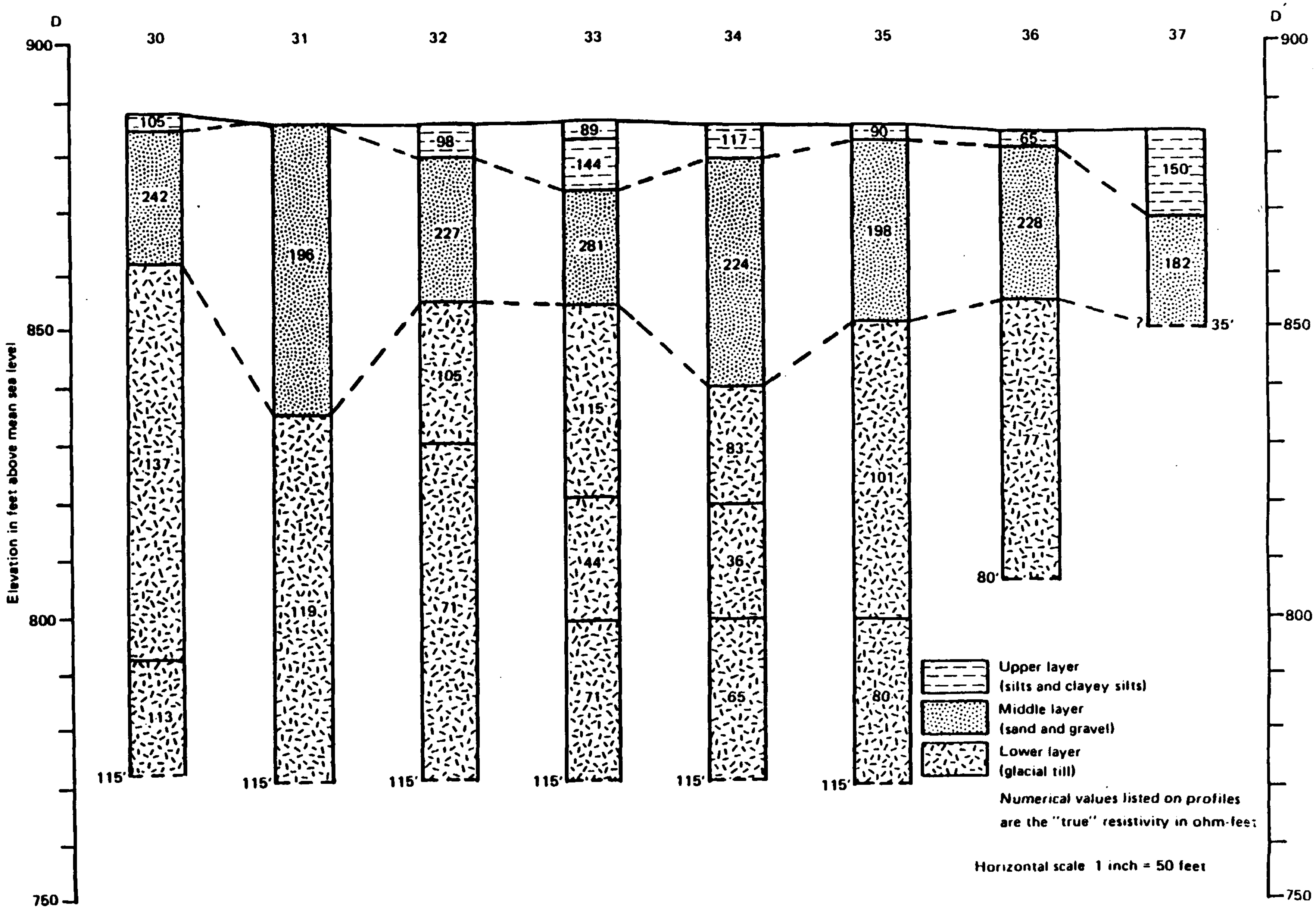


FIGURE 8. Geoelectric section for stations along traverse D-D' on the western side of the ECC-Site. Stations were located 25 feet west of the site fence.

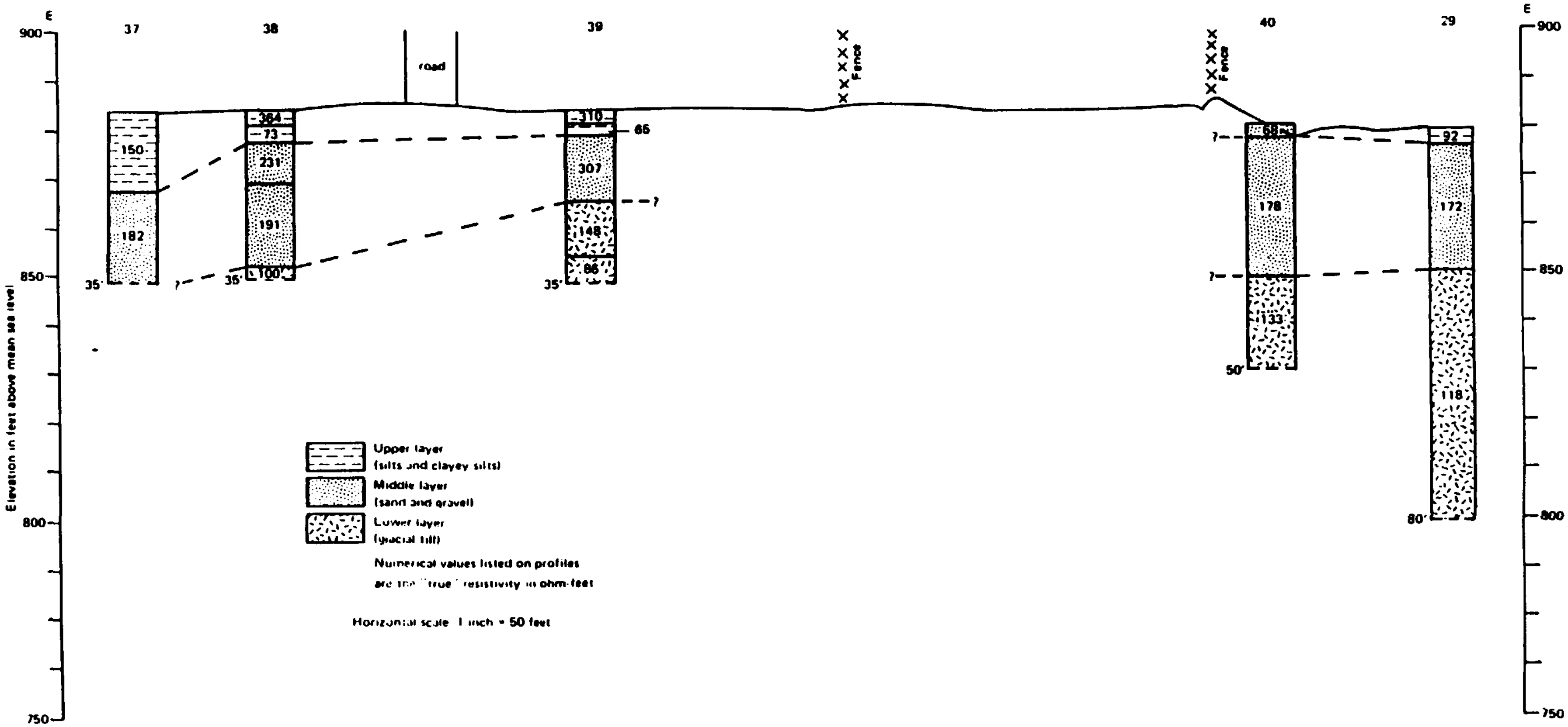


FIGURE 9. Geoelectric section for stations along traverse E-E' on the southern side of the ECC-Site.

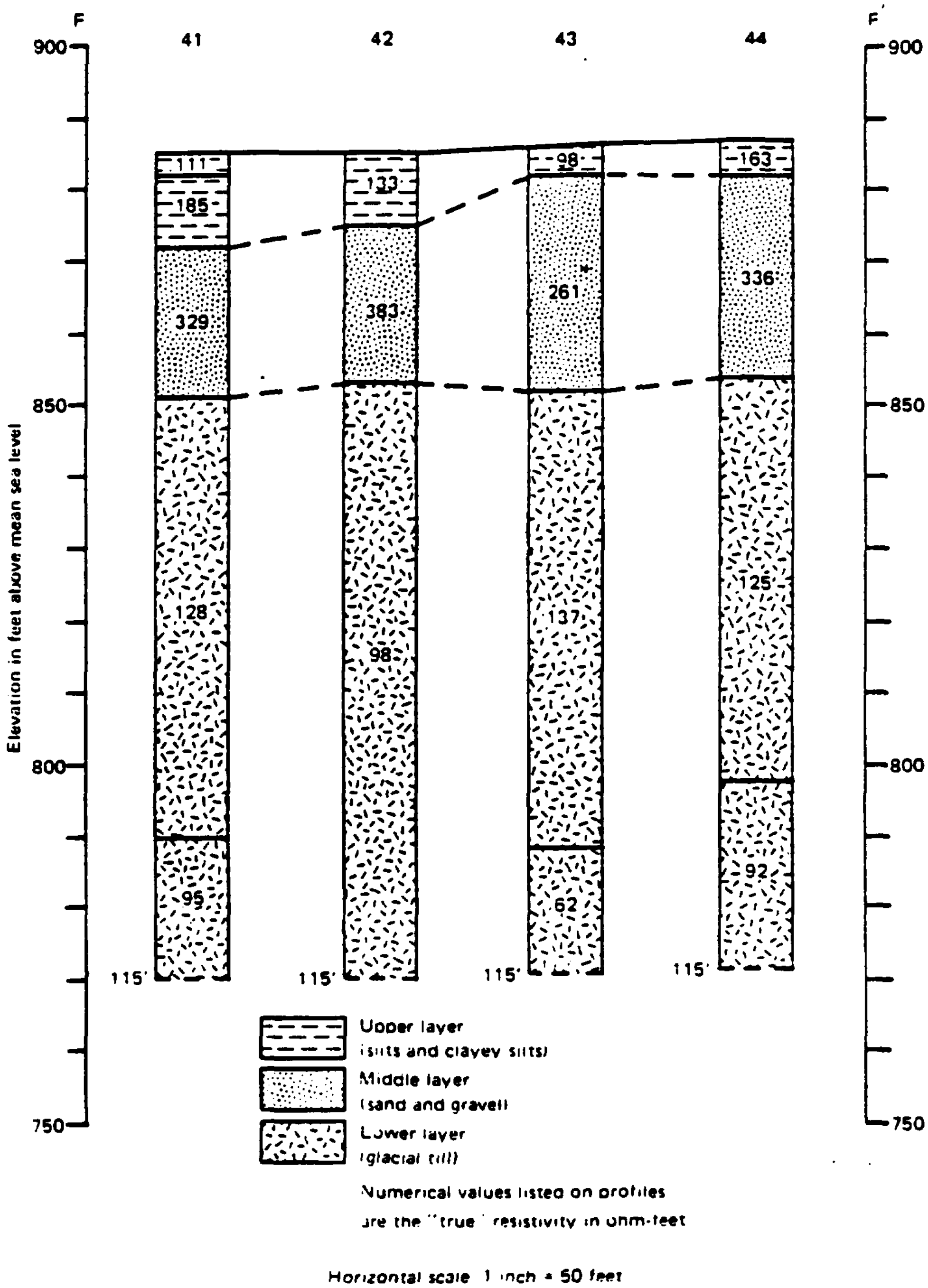


FIGURE 7. Geoelectric section for regional stations along traverse F-F' located 45 feet west of the metal fence on the west side of the ECC-Site.

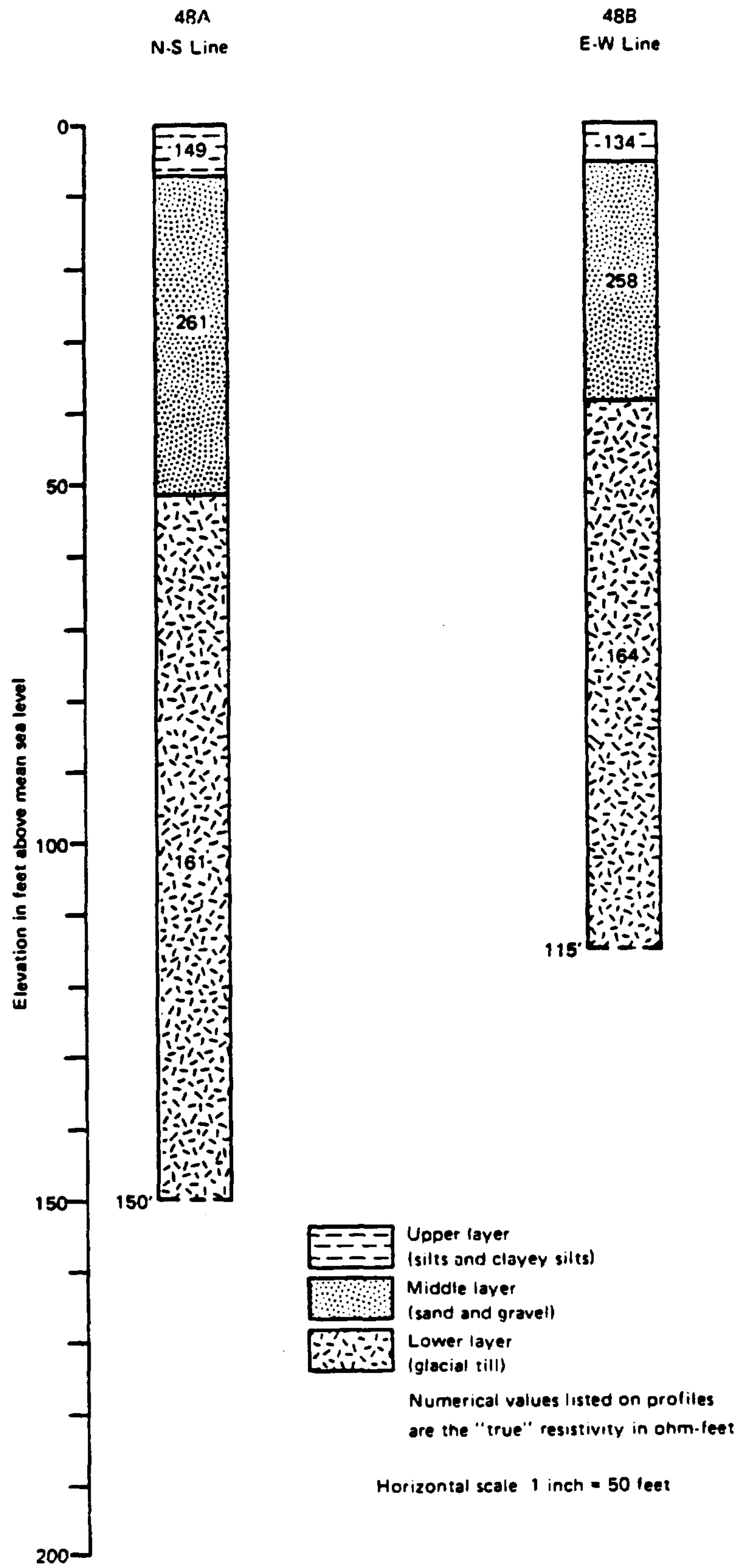


FIGURE 6. Strip records showing layering parameters for two sets of measurements taken at station no. 48. VES-48A is for a north-south alignment of electrical lines; VES-48B is an east-west alignment.

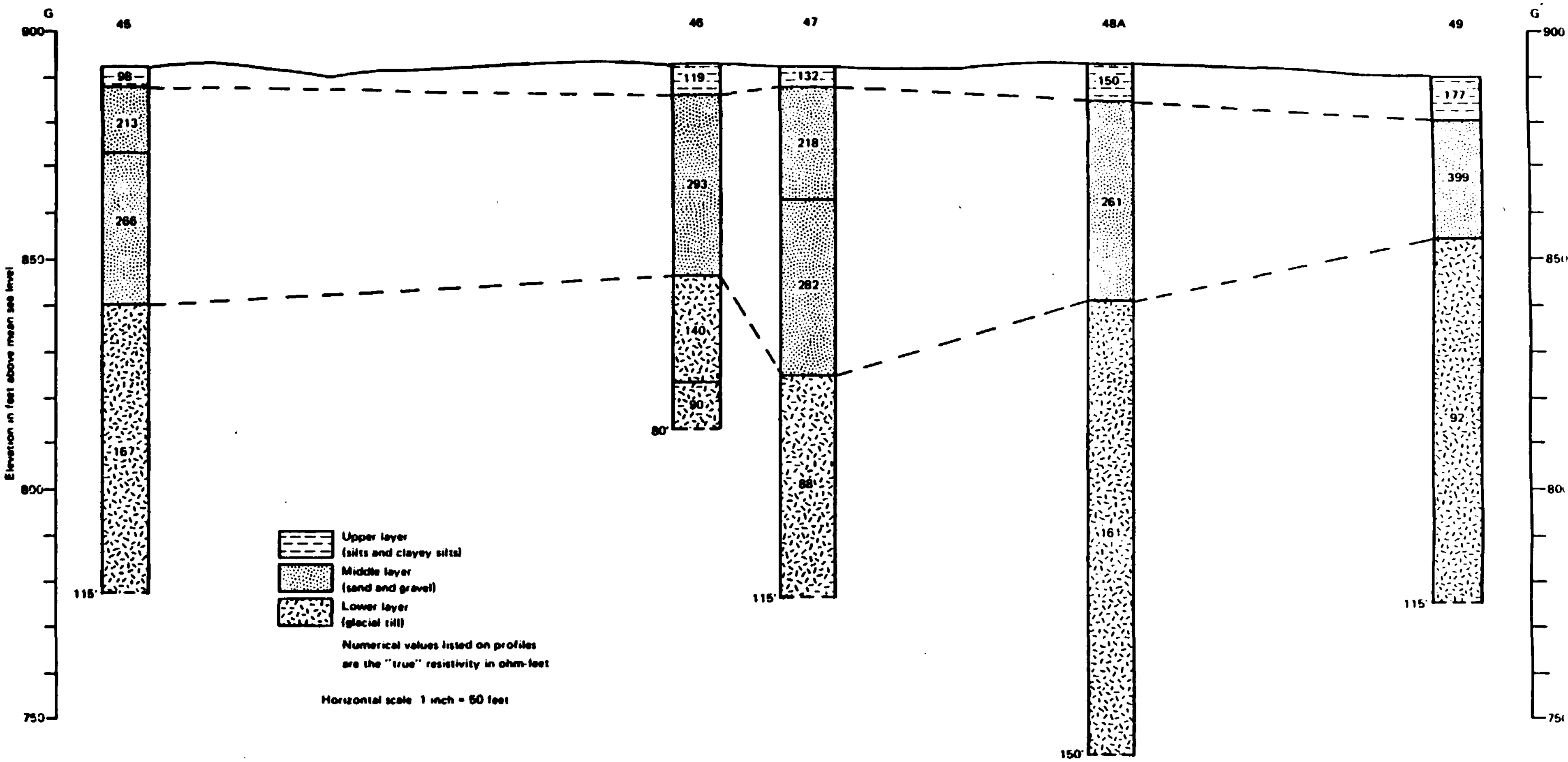


FIGURE 5. Geoelectric section for regional stations along traverse G-G' located in the western part of the study area.

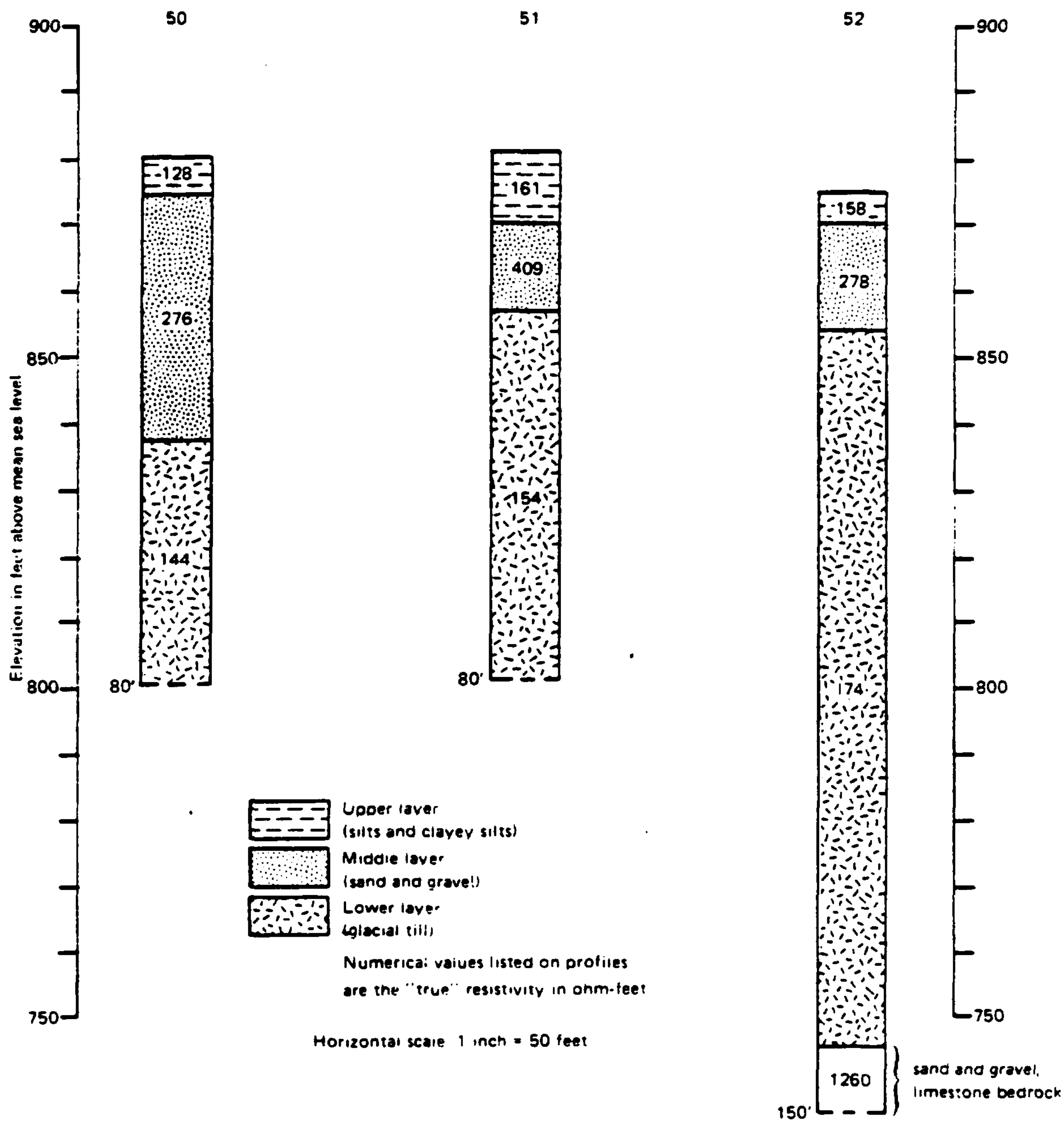


FIGURE 4. Strip records showing layering parameters for regional stations located south of the ECC-Site.

An example shown in figure 4 is the "true" resistivity of 1260 ohm-feet measured for geologic materials at depths greater than 140 feet at VES-52. A resistivity value of this magnitude is reasonable for the limestone bedrock. However, the available space in the study area did not allow the long current electrode separation distances necessary to accurately characterize the deeply buried limestone bedrock. Also, the very high resistivity of the limestone bedrock "masks" detection of the overlying basal sand and gravel deposits.

Table 1 compares the thickness and depth interval for the middle high resistivity layer (sand and gravel) at VES stations to the thickness of sand and gravel reported in drillers records for shallow borings at nearby locations. The approximate distance separating the VES stations and the borings is listed in the table. The layering parameters determined for the VES-profiles compare well to the drillers records, especially when the VES station and the boring are located close together.

Because of the significance of the drainageways to shallow groundwater flow systems and also because the shallow geologic materials can vary greatly over short lateral distances, it was necessary to locate VES stations between the drainageways and the metal fence that surrounds the ECC Site. The affect of the metal fence on the electrical measurements is problematic and was a reason for the decision to take all measurements with the VES method.

Table 2 presents the range in layering parameters determined for geologic materials in different parts of the study area; the values determined for the traverses in the immediate vicinity of the site and the landfill are evaluated separately from the 16 regional stations where electrical interference is less of a problem.

At the 16 regional stations, the "true" thickness of the middle layer (sand and gravel deposits) were determined to vary from 14 to 60 feet. The thickest deposits

TABLE 1

For the Vicinity of the Environmental Conservation and Chemical Corporation Site, A Comparison of the Distribution of Coarse-Grained Geologic Materials Interpreted from Vertical Electrical Soundings with Drillers Records from Shallow Borings

VES station no. or boring no.[a]	Total depth feet	Sand and gravel[b]		
		Thickness feet	Depth interval feet	Elevation interval feet
Northwest[c]				
VES-30	115	24	2-26	884-860
ECC-1C	171	9	25-34	865-856
VES-45	115	32	19-51	873-841
Western[d]				
VES-37	35	19	16≥35	868≤849
ECC-5A	32	15	17≥32	869≤854
VES-36	80	25	4-30	880-854
North[e]				
VES-7	115	36	16-52	878-842
SB-59	50.5	26	23-49	869-843
Northeast[f]				
ECC-2C	165.6	20	16-36	871-851
VES-11	55	39	12-51	879-840
VES-15	115	21	5-26	884-863
East[g]				
SB-68	30	primarily fine-grained materials, 3 feet of silty sand in the depth interval of 18-21 feet		
VES-12	80	low resistivity values—fine-grained materials		
ECC-4C	165.9	primarily fine-grained materials, few thin sand layers in the depth interval of 8-15 feet		

TABLE 1 (Continued)

VES station no. or boring no.[a]	Total depth feet	Sand and gravel[b] Thickness feet	Depth interval feet	Elevation interval feet
East[h]				
VES-25	150	25	13-38	873-848
SB-79	38	24	12-36	873-849
Southeast[i]				
VES-14	80	32	3-35	880-848
SB-76	28.8	≥21.8	7≥28.8	876≤854
South[j]				
VES-40	50	28	2-30	878-850
SB-57	30.5	9	0-9	880-871
"	"	5	23.5-28.5	856.5-851.5
South[k]				
VES-29	80	25	3-28	876-851
SB-60	30	7	8-15	869-864
South[l]				
SB-54	30	23	0-23	873-850
VES-52	150	16	5-21	869-853
SB-55	25	23	0-23	872-849

a. The drillers records for the borings are in Appendix II. The approximate locations of the SB-borings are shown on a figure in Appendix II.

b. Sand and gravel present to a depth of not greater than 60 feet.

c. Boring ECC-1C is located approximately 50 feet west of VES-30 and 175 feet east of VES-45.

d. Boring no. ECC-5A is located along the western side of the site approximately 25 feet west of VES-37 and 60 feet south of VES-36.

e. Boring no. SB-59 is located along the north side of the site approximately 10 feet north of VES-7.

f. Boring no. ECC-2C is located 62 feet northeast of the northeastern corner of the site fence, approximately 100 feet northeast of VES-15 and 70 feet northeast of VES-11.

g. Boring SB-68 is located approximately 10 feet north of VES-12; boring ECC-4C is located approximately 90 feet south of VES-12.

h. Boring SB-79 is located within the ECC-Site on the south side of the lagoon approximately 60 feet east of VES-25.

TABLE 1 (Continued)

i. Boring SB-76 is located approximately 20 feet south of VES-14.

j. Boring SB-57 is located along the south side of the site approximately 10 feet north of the location of VES-40.

k. Boring SB-60 is located along the south side of the site approximately 10 feet north of the location of VES-29.

l. Boring SB-54 and SB-55 are located in the southern part of the study area. Boring SB-54 is located approximately 60 feet northeast of VES-52; boring SB-55 is located approximately 50 feet southwest of VES-52.

TABLE 2

The Range in Layering Parameters—"True" Thickness and "True" Resistivity for VES-Profiles at Measurement Stations in The Study Area

	Upper layer (silts, clayey silts)		Middle layer (sand and gravel)		Lower layer (glacial till)	
	thickness feet	resistivity ohm-feet	thickness feet	resistivity ohm-feet	thickness feet	resistivity* ohm-feet
16 regional stations away from the ECC Site or landfill	2-11	72-191	14-60	213-409	∿100	90-174
Stations on traverses near ECC Site						
B-B'	3-13	61-173	9-30	149-291	∿100	50-142
C-C'	7-22	86-128	22-40	156-182	> 80	90-124
D-D'	0-16	65-150	19-51	182-281	> 90	77-137
E-E'	3-16	65-364	14-28	172-307	> 50	118-148
Stations near the landfill on traverse A-A'	3-5	70-120	0-39	176-294	∿100	57-115

*The range does not include some anomalously low values and anomalously high values that were measured in thin layers or at the bottom of profiles.

are present in the northern and western part of the study area. The "true" resistivity of the middle layer at the 16 regional stations varied from 213 to 409 ohm-feet.

At station no. 48 on traverse G-G'; two separate sets of measurements were taken with north-south (VES-48A) and east-west (VES-48B) alignments of the electrode arrays. The layering parameters for the two VES-profiles are shown in figure 6. The layering parameters are very similar; the significant difference is a greater thickness of the middle layer for VES-48A.

The VES-profiles in figure 1 and 2 illustrate the lower apparent resistivity values that were measured at stations located near the metal fence surrounding the ECC Site. The shape of all 4 curves is characteristic of the 3-layer case where the middle layer has higher resistivity, but the apparent resistivity values are systematically lowered for the stations that are located near the metal fence. The range of values listed in Table 2 demonstrate that the "true" resistivity values for the middle layer are lower for stations near the ECC Site than for the regional values. The lowest values were for stations located along traverse C-C' on the north side of the site between the metal fence and a woven wire farm fence. The ground surface and fences were wet from a rain storm when measurements were taken along this traverse. The systematic lowering of the "true" resistivity values for the middle layer is also evident when the strip records in figures 7 and 8 for stations along traverse F-F' and D-D' are compared. The stations on traverse F-F' are located 20 feet west of traverse D-D' on the west side of the drainageway.

An important control on the resistivity of sand and gravel deposits is the ionic strength of the contained groundwater. Therefore, water quality data from monitoring wells in the vicinity of the ECC Site were acquired from the Indiana Department of Public Health to investigate the possibility that the lower resistivities near the ECC Site were due to the presence of contaminants that had increased the ionic strength of the shallow groundwater. Analyses for chloride, total dissolved solids and specific conductance are tabulated for groundwater samples from 9 shallow monitoring wells in the study area on a map in Appendix III.

The values for chloride, total dissolved solids, and specific conductance for groundwater from 2 wells located north of the site (no. 58 and no. 59) and 1 well on the site (no. 57 located south of the lagoon) are very similar to values for those constiuents in monitoring well no. 37 located in the grass field west of the site. Specific conductance varies from 560 to 620 μ siemens/cm for the 3 wells in the vicinity of the site compared to a value of 605 μ siemens/cm for groundwater from well no. 37. Higher values for chloride, total dissolved solids and specific conductance were measured in 2 wells located immediately south of the ECC Site. For specific conductance the values range from 585-670 μ siemens/cm at well no. 57 and from 1060 to 1230 μ siemens/cm at well no. 60. Note that the highest concentration for the three constiuents were measured in shallow monitoring wells located in the southern part of the study area. Specific conductances of 1300 and 1500 μ siemens/cm were measured at well no. 56 and no. 55 respectively.

The increase in ionic strength in groundwater south of the site is sufficient to cause a decrease in the resistivity values measured for the sand and gravel deposits. However, the decrease that has occurred is not evident in the "true" resistivity values at either station no. 29 that is located near monitoring well no. 60 or at station no. 52 that is located in the vicinity of monitoring wells no. 55 and no. 56. The decline in resistivity that has occurred cannot be evaluated without values for baseline resistivities before the contamination occurred.

It is highly probable that electrical interference by the metal fences is the major reason for the lower resistivity values at stations near the ECC Site. Although the "true" resistivity of the middle layer is lowered at these stations, the depth interval of the layer correlates well with sand and gravel deposits reported in drillers records for nearby borings. Examples listed in Table 1 are VES-37 and ECC-5A on the western side, VES-7 and SB-59 on the north side, VES-25 and SB-79 on the east side, VES-40 and SB-57 on the south side and VES-29 and SB-60 at the southeast corner of the site. The data indicate that sand and gravel deposits are present at a shallow depth throughout the vicinity of the ECC Site; at depth the sand and gravel deposits are underlain by thick deposits of glacial till. The "true" thickness of the sand and gravel deposits ranges from 10 to 50 feet. The thickest deposits were present at stations located on the north, east and southeast sides of the site.

The shallow sand and gravel deposits are absent in a locality that is directly east of the northeastern part of the ECC Site on the eastern side of the unnamed drainageway. The low "true" resistivity values determined at VES-12 shown on traverse A-A' in figure 12 indicate that the geologic materials to a depth of at least 80 feet are primarily fine-grained. This interpretation is supported by the drillers records for two borings (SB-68 and ECC-4C) that are located in the same locality. The data indicate that in this locality the sand and gravel deposits terminate a short distance east of the ECC Site approximately along a line that is marked by the drainageway. The southern distance to which the sand and gravel deposits are absent on the east side of the drainageway is not well-defined. The layering parameters determined for staions VES-13 and VES-14 indicate that the middle layer (sand and gravel deposits) is present in the southern part of traverse A-A'. This interpretation is supported by the drillers records at boring SB-76. VES-13 is located approximately 110 feet south of boring ECC-4C.

Conclusions

A surface electrical earth resistivity investigation in the vicinity of the ECC Site identified 3 layers in the unlithified geologic materials present to depths of greater than 100 feet—1) an upper layer of low resistivity materials interpreted to be silts and clayey silts, 2) a middle layer of high resistivity materials interpreted to be sand and gravel, and 3) a thick layer of low resistivity materials interpreted to be fine-grained glacial till. The lower layer is present throughout the entire study area. The middle layer (sand and gravel) occurs over most of the study area and is only known to be absent in a small locality in the northeastern part. Thickness of the sand and gravel is interpreted to vary from 0 to approximately 60 feet. The thickest deposits are present in the northern and western parts of the study area. The resistivity values indicate that the sand and gravel deposits are present throughout the vicinity of the ECC Site.

Because of the absence of baseline values, the resistivities measured in the study cannot be related to the presence of contaminants in the shallow groundwater. Electrical interference by the metal fence is believed to be the major reason for the lower resistivity values measured for the middle layer in the immediate vicinity of the ECC Site. A significant aspect of the field study was the finding that the layering parameters of geologic materials to depths of greater than 100 feet can be determined from vertical electrical sounding measurements taken at stations that are located within 5 to 10 feet of metal fences.

References

Zohdy, A.A.R., 1973. A Computer Program for the Automatic Interpretation of Schlumberger Sounding Curves Over Horizontally Stratified Media. National Technical Information Service, U.S. Dept. of Commerce PB-232703, 32 p.

Plate 1. The Study Area for the Surface Electrical Earth Resistivity Investigation in the Vicinity of the ECC-Site. The Map Shows the Locations of VES Stations and the Traverse Lines for Geoelectrical Sections.

APPENDIX I

Apparent Resistivities* For Vertical Electrical Sounding
Profiles At Stations Located On The Environmental Conservation
And Chemical Corporation Site

Current electrode separation distance (feet)	m	Vertical electrical sounding station no.** 1	2	3	4	5	6
		apparent resistivity (ohm-feet)					
6.6	2	92.20	75.47	114.76	192.14	120.13	96.43
9.6	3	101.84	81.93	115.06	203.09	113.61	99.61
14.2	4.3	139.89	102.46	128.57	167.18	113.22	102.79
20.7	6.3	165.08	112.40	147.99	161.17	116.86	111.48
30.4	9.3	178.56	134.11	161.60	164.75	124.90	120.17
44.6	13.6	195.75	158.71	179.61	172.10	134.74	126.41
65.6	20	215.92	189.94	205.45	190.69	145.79	132.02
96.4		223.95	210.83	216.90	213.23	141.66	125.98
141.4		227.33	211.59	222.44	209.85	137.49	119.91
207.4		225.20	223.56	201.22	208.21	122.18	105.51
304.6		222.28		227.14	188.00		91.08
447.0							116.34
656.0							98.38

*Apparent resistivities in ohm-feet as a function of the distance separating the current electrodes in feet (Schlumberger Electrode Array).

**The locations of the stations are shown on the base map.

APPENDIX I (Con't)

Apparent Resistivities For Vertical Electrical Sounding Profiles At Stations Located On The Environmental Conservation And Chemical Corporation Site

Current electrode separation distance (feet)	Vertical electrical sounding station no. 7	8	9	10	11	12
	apparent resistivity (ohm-feet)					
6.6	104.99	82.26	118.24	119.78	125.91	85.21
9.6	108.86	97.97	113.25	131.95	134.48	90.29
14.2	113.42	100.04	109.74	128.47	142.77	87.77
20.7	114.27	101.71	106.20	124.44	151.04	99.31
30.4	116.41	112.60	115.91	131.29	153.14	88.88
44.6	119.81	126.05	121.55	134.48	155.24	92.33
65.6	125.39	135.59	133.56	137.62	154.68	87.67
96.4	135.39	139.49	137.33	147.66	154.09	114.34
141.4	142.74	139.03	133.66	146.22	148.02	69.99
207.4	130.08	132.18		144.74		48.74
304.6	126.80	115.91				
447.0						
656.0						

*Apparent resistivities in ohm-feet as a function of the distance separating the current electrodes in feet (Schlumberger Electrode Array).

APPENDIX I (Con't)

Apparent Resistivities* For Vertical Electrical Sounding Profiles At Stations Located On The Environmental Conservation And Chemical Corporation Site

Current electrode separation distance (feet)	Vertical electrical sounding station no. 13	14	15	16	17	18
	apparent resistivity (ohm-feet)					
6.6	111.61	72.48	118.34	131.98	116.73	196.20
9.6	117.32	75.99	117.55	140.54	108.60	161.50
14.2	120.63	91.61	114.76	138.15	118.04	144.94
20.7	123.95	106.76	118.80	139.36	118.30	128.34
30.4	146.55	135.98	136.02	143.92	118.53	125.82
44.6	156.48	159.24	142.38	155.37	120.14	129.88
65.6	166.39	183.45	147.30	162.36	131.00	125.00
96.4	166.75	178.69	138.21	156.02	126.41	125.06
141.4	148.84	139.89	129.13	141.63	115.88	108.40
207.4	130.90		129.03	120.63		82.13
304.6	129.06		128.93			71.56
447.0	127.19		122.08			
656.0	105.51		115.19			

*Apparent resistivities in ohm-feet as a function of the distance separating the current electrodes in feet (Schlumberger Electrode Array).

APPENDIX I (Con't)

Apparent Resistivities* For Vertical Electrical Sounding Profiles At Stations Located On The Environmental Conservation And Chemical Corporation Site

Current electrode separation distance (feet)	19	20	21	22	23	24
	Vertical electrical sounding station no.					
	apparent resistivity (ohm-feet)					
6.6	128.96	153.89	96.49	109.58	92.29	106.00
9.6	119.16	144.71	109.12	117.39	107.55	110.10
14.2	116.07	130.97	122.67	125.19	121.91	120.47
20.7	119.75	132.54	136.18	136.90	136.28	128.31
30.4	129.16	134.11	144.32	148.58	150.68	138.41
44.6	142.02	145.79	152.45	164.62	160.35	151.14
65.6	113.84	157.47	153.43	161.08	163.14	149.86
96.4	85.64	150.09	137.56	145.27	142.94	142.64
141.4	74.78	134.64	117.62	105.18	120.67	113.32
207.4		118.17	93.31	84.78	89.83	89.60
304.6		101.71		86.16	79.11	
447.0				87.51	88.46	
656.0				82.82	64.94	

*Apparent resistivities in ohm-feet as a function of the distance separating the current electrodes in feet (Schlumberger Electrode Array).

APPENDIX I (Con't)

Apparent Resistivities* For Vertical Electrical Sounding Profiles At Stations Located On The Environmental Conservation And Chemical Corporation Site

Current electrode separation distance (feet)	Vertical electrical sounding station no. 25	26	27	28	29	30
	apparent resistivity (ohm-feet)					
6.6	161.54	84.82	184.00	177.28	97.41	119.22
9.6	153.53	103.15	167.28	156.98	103.64	130.18
14.2	145.50	113.88	150.55	143.92	107.71	151.60
20.7	140.64	120.11	158.55	147.07	137.30	184.04
30.4	146.35	126.34	166.52	154.45	151.07	205.68
44.6	152.06	146.55	180.26	165.90	166.46	204.60
65.6	159.90	148.35	194.01	171.28	181.84	203.75
96.4	164.39	148.25	182.23	164.39	172.23	194.17
141.4	141.63	121.68	160.88	141.63	162.62	193.02
207.4	125.46	92.03	123.78	112.89	135.26	148.87
304.6	109.25	71.20	86.65			139.40
447.0	105.05					210.14
656.0						212.38

*Apparent resistivities in ohm-feet as a function of the distance separating the current electrodes in feet (Schlumberger Electrode Array).

APPENDIX I (Con't)

Apparent Resistivities* For Vertical Electrical Sounding Profiles At Stations Located On The Environmental Conservation And Chemical Corporation Site

Current electrode separation distance (feet)	Vertical electrical sounding station no. 31	32	33	34	35	36
	apparent resistivity (ohm-feet)					
6.6	188.56	89.77	95.12	115.65	97.87	72.35
9.6	189.45	95.08	108.76	118.60	121.03	91.24
14.2	190.30	100.56	114.17	121.52	140.97	112.97
20.7	201.22	116.83	121.39	133.20	160.91	144.51
30.4	200.44	142.41	138.25	147.30	178.46	171.74
44.6	207.68	159.24	162.03	171.41	180.92	182.49
65.6	199.68	172.10	177.77	183.45	183.45	189.94
96.4	188.20	167.96	179.87	188.20	171.54	176.30
141.4	174.88	152.12	166.13	167.87	153.89	150.38
207.4	156.32	123.19	134.18	130.90	128.34	125.75
304.6	143.17	101.71	107.71	101.71	109.25	
447.0	188.01	132.71	143.76			
656.0	178.60					

*Apparent resistivities in ohm-feet as a function of the distance separating the current electrodes in feet (Schlumberger Electrode Array).

APPENDIX I (Con't)

Apparent Resistivities* For Vertical Electrical Sounding Profiles At Stations Located On The Environmental Conservation And Chemical Corporation Site

Current electrode separation distance (feet)	Vertical electrical sounding station no. 37	38	39	40	41	42
	apparent resistivity (ohm-feet)					
6.6	140.22	302.77	502.66	98.95	116.73	135.59
9.6	143.40	251.34	310.41	125.91	129.26	133.43
14.2	145.66	168.75	233.79	128.18	137.69	134.84
20.7	150.25	129.85	161.90	139.36	146.51	144.09
30.4	154.84	137.13	171.41	155.96	165.83	162.06
44.6	160.35	152.06	194.66	172.33	189.97	188.23
65.6	161.54	166.39	210.24	168.03	212.05	217.16
96.4	167.96	160.81	182.23	160.81	216.18	218.41
141.4				155.63	203.39	205.91
207.4					180.53	175.84
304.6					153.76	145.96
447.0					199.68	
656.0					186.17	

*Apparent resistivities in ohm-feet as a function of the distance separating the current electrodes in feet (Schlumberger Electrode Array).

APPENDIX I (Con't)

Apparent Resistivities* For Vertical Electrical Sounding Profiles At Stations Located On The Environmental Conservation And Chemical Corporation Site

Current electrode separation distance (feet)	Vertical electrical sounding station no. 43	44	45	46	47
	apparent resistivity (ohm-feet)				
6.6	95.84	71.01	107.22	114.93	140.18
9.6	106.20	76.12	122.08	122.67	152.45
14.2	126.60	109.81	151.79	126.47	164.72
20.7	150.38	125.55	157.07	147.50	175.54
30.4	174.59	156.16	177.38	160.94	186.20
44.6	190.30	186.82	197.42	184.13	196.86
65.6	211.56	220.74	210.24	209.19	208.60
96.4	207.19	231.89	225.86	227.89	216.80
141.4	192.73	218.21	228.38	216.84	225.59
207.4	172.79	181.64	227.40	193.02	213.03
304.6	136.02	151.47	216.77	—	192.14
447.0			254.40	287.30	205.65
656.0					219.16

*Apparent resistivities in ohm-feet as a function of the distance separating the current electrodes in feet (Schlumberger Electrode Array).

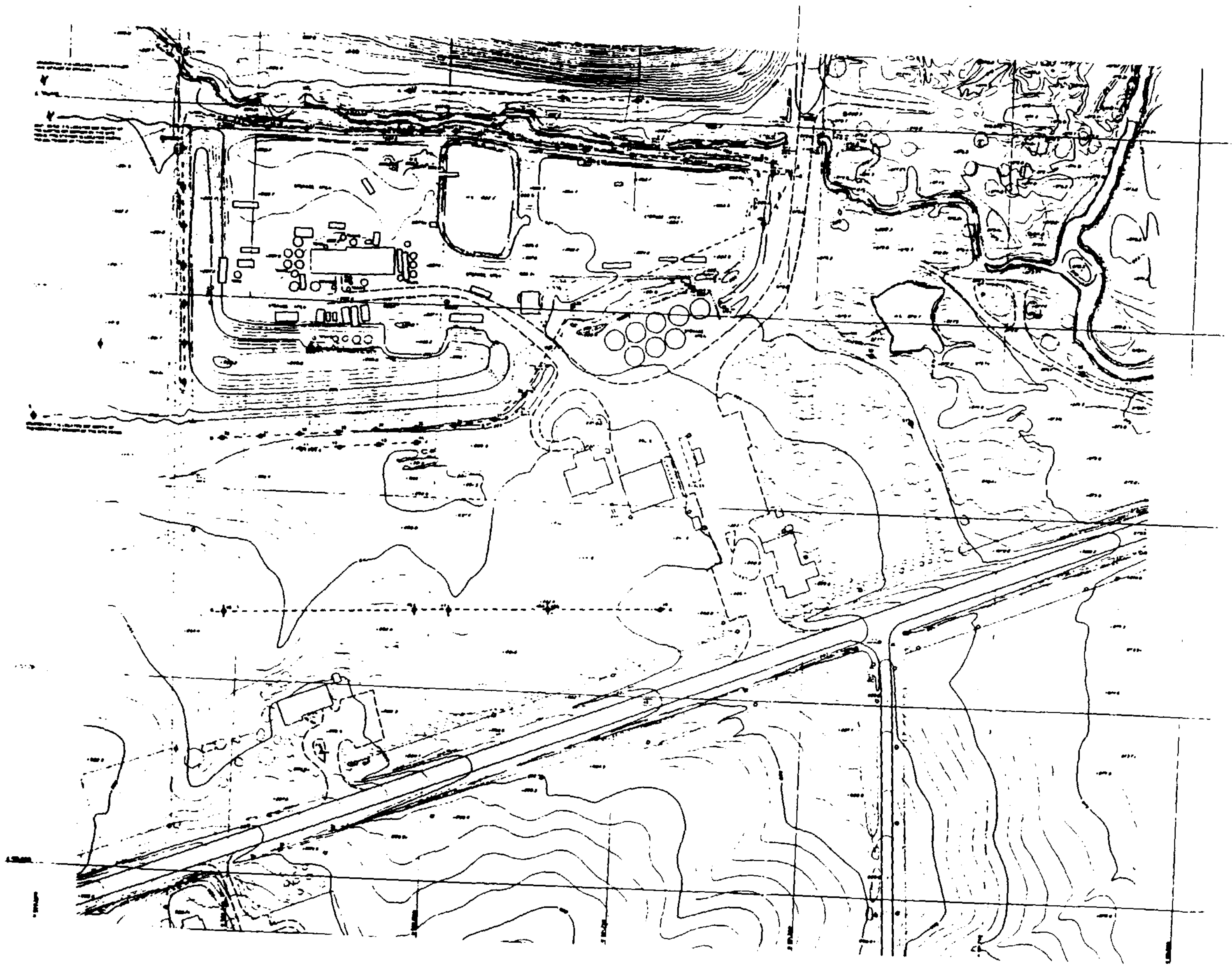


PLATE 1

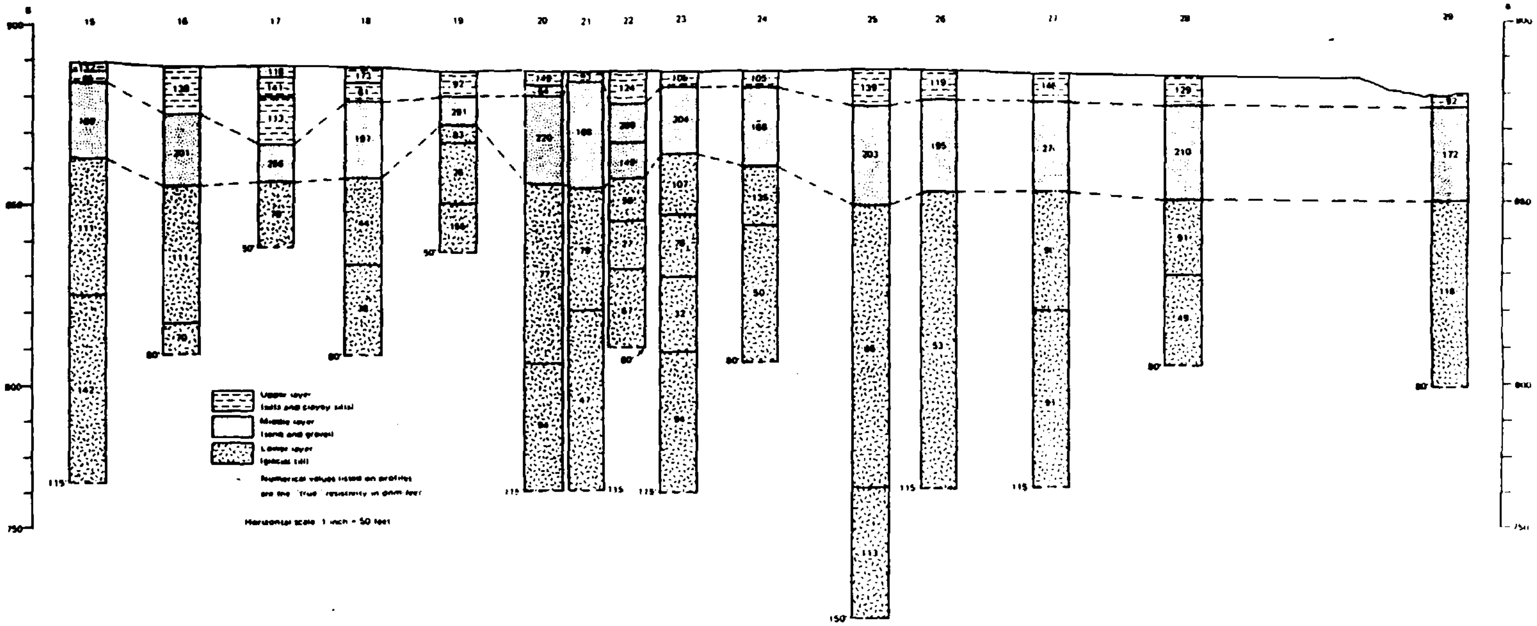


FIGURE 11. Geoelectric section for stations along traverse B-B' on the eastern side of the ECC-Site. Stations were located 5-10 feet east of the site fence.

TECHNICAL MEMORANDUM
Subtask 3-1

Appendix B
BORING LOGS

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-1A	SHEET 1 OF 2

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTHWEST CORNER
ELEVATION 887.20 DRILLING CONTRACTOR MATECO DRILLING CO.
DRILLING METHOD AND EQUIPMENT CME 550 RIG, HSA TO 36', 6" O.D., 3 3/4" I.D.
WATER LEVEL AND DATE 6.5' - 6/1/83 - 1440 HRS START 6/1/1983 FINISH 6/2/83 LOGGER D.W. LOVELL

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS BLOWS PER 6 INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0–2	X	SS-1	18"	2-3-5-5	SANDY SILTY CLAY, BROWN AND BLACK, MOIST TOPSOIL WITH GRASS ROOTS (cl) 1.0'		
	2–4	X	SS-2	14"	3-3-3-6	SILTY CLAY, MOTTLED BROWN AND GRAY, MOIST, MEDIUM STIFF, TRACE SAND		
	4–6	X	SS-3	12"	7-12-18-23	(CL)		
	6–8	X	SS-4	15"	9-14-18-19	7.5'		
	8–10	X	SS-5	18"	5-8-9-12	SILTY CLAY, GRAY, MOIST, MEDIUM STIFF, SOME SAND (cl)		
	10–12	X	SS-6	21"	5-7-8-13	11.5'		SATURATED SOIL AT 11.5'
	12–14	X	SS-7	18"	4-5-7-7	SILTY SAND, FINE, GRAY, WET, MEDIUM DENSE (sm) 12.5'		
	14–16	X	SS-8	12"	3-7-16-14	SILTY CLAY, GRAY, WET, MEDIUM STIFF, TRACE SAND (CL-ML)		
	16–18	X	SS-9	22"	4-6-4-5	17.0' SILTY CLAY, GRAY, WET,		
	18–20	X	SS-10	21"	3-4-7-9	SOME SAND, MEDIUM STIFF TRACE GRAVEL		
	20–24.5					(cl) T O		
	24.5–26.0	X	SS-11	16"	11-18-22	25.0' SAND, FINE TO MEDIUM, GRAY, MOIST TO WET, DENSE (sp-sw) 28.0'		SAND BLOWING INTO BOTTOM OF HOLLOW-STEM-AUGER WATER LEVEL RISING TO ~6 FT. BELOW GROUND SURFACE
	28.5–30.0	X	SS-12	11"	6-8-10	SILTY CLAY, MOTTLED TAN AND BROWN, MOIST TO WET, STIFF (CL-ML)		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-1A	SHEET 2 OF 2

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTHWEST CORNER

ELEVATION 887.20 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, HSA TO 36', 5½" ROTARY BIT TO 40'

WATER LEVEL AND DATE 3.5'-6/2/83-0900 HRS START 6/1/83 FINISH 6/2/83 LOGGER D.W. LOVELL

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS BLOWS PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	32					33.5'		
	34	34.5						
			SS-13	10"	25-41-57/3"	SILTY CLAY, BROWN-GRAY, MOIST, SOME SAND, TRACE GRAVEL, HARD (CL)		PUSHED 6" CASING TO ~22 FT. THEN DROVE CASING W/300# HAMMER TO ~29 FT. DRILLED W/5½" ROTARY BIT FROM 36 TO 40 FT.
	36	35.7						
	38							
	40					BOTTOM OF BORING 40.0'		
								SET MONITORING WELL TIP AT 28.5 FT.

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-1C	SHEET 1 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTHWEST CORNER

ELEVATION 886.70 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME-550 RIG HSA TO 8', ROTARY BIT W/CLEAR WATER TO 30'

WATER LEVEL AND DATE 3.9'-6/3/83-0800 HRS START 6/2/83 FINISH 6/3/83 LOGGER I.H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS BLOWS PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	2					NOT SAMPLED FROM 0' TO 23.5'		OFFSET AND DRILLED WITHOUT SAMPLING TO 23.5 FT - SEE ECC-1A LOG FOR SHALLOW SOIL UNITS
	4							
	6							
	8							
	10							SET HSA'S TO 8' THEN PUSHED 6" CASING TO 8'
	12							
	14							
	16							
	18							
	20							
	22					~23.5		HOLE CAVED BELOW 23.5' PUSHED 6" CASING TO 18' DROVE 6" CASING TO 30' WITH 300# HAMMER
	24	23.5 – 25.0	SS-1	18"	6-10-13	SAND, FINE TO COARSE, GRAY, WET, MEDIUM DENSE, SOME FINE GRAVEL (SW)		
	26							
	28							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-1C	SHEET 2 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTHWEST CORNER

ELEVATION 886.70 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME-550 RIG, 3½" DRAG BIT, BENTONITE MUD BELOW 30'

WATER LEVEL AND DATE 9.33'-6/4/83-0600 HRS START 6/2/83 FINISH 6/3/83 LOGGER I. H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS BLOWS PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30	29.5–31.0	SS-2	10"	14-16-18	SAND, FINE, GRAY, WET, DENSE, SOME SILT (SM) 32.5'		SET 4" CASING TO 30' INSIDE OF 6" CASING, THEN DROVE 4" CASING TO 34'
	32							VERY HARD DRILLING BELOW 32.5'
	34–36	34.5–36.0	SS-3	14"	27-52-55	SILTY CLAY, GRAY, MOIST, HARD, SOME SAND, TRACE GRAVEL (CL-ML)		
	38–40	39.5–41.0	SS-4	17"	26-32-60	CLAY, GRAY, MOIST, HARD, WITH FINE TO COARSE SAND, AND FINE GRAVEL (CL)		
	42–46	44.5–46.0	SS-5	16"	28-39-60	SILTY CLAY, GRAY, MOIST, HARD, TRACE SAND (cl)		
	48–50	49.5–51.0	SS-6	18"	13-21-25	CLAY, GRAY, MOIST, HARD, TRACE SAND. (cl)		
	52–56	54.5–56.0	SS-7	18"	16-24-29	SILTY CLAY, MOTTLED GRAY AND BROWN, MOIST, HARD, TRACE SAND (CL-ML)		
	58							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-1C	SHEET 3 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTHWEST CORNER

ELEVATION 886.70 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 30'

WATER LEVEL AND DATE 2.3'-6/5/83-0630 HRS START 6/2/83 FINISH 6/8/83 LOGGER I.H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6" (N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60	59.5'–61.0	SS-8	12"	11-17-29	SILTY CLAY, BLUE-GRAY, MOIST TO WET, HARD (cl) 60.5'		
	62	62.0–63.5	SS-9	18"	18-13-19	SAND, FINE TO COARSE, GRAY, WET, DENSE (SP) 62.5'		
	64–66	64.5–65.5	SS-10	13"	25-52	SILTY CLAY, GRAY, MOIST, HARD, SOME FINE TO COARSE SAND (CL)		
	68							
	70	69.5–70.5	SS-11	12"	46-57	SILT, GRAY, MOIST, HARD, TRACE CLAY, TRACE SAND (ml)		
	72							
	74–76	74.5–76.0	SS-12	12"	30-24-30	SILT, BROWN, MOIST, HARD, WITH FINE TO COARSE SAND AND FINE GRAVEL (ML)		
	78							
	80	79.5–80.5	SS-13	11"	46-60/5"	SILT, BROWN, MOIST, HARD WITH FINE TO COARSE SAND AND FINE GRAVEL (ML)		
	82							
	84–86	84.5–86.0	SS-14	18"	23-31-45	SILT, BROWN, MOIST, HARD, TRACE FINE SAND (ml)		
	88							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-1C	SHEET 4 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTHWEST CORNER
ELEVATION 886.70 DRILLING CONTRACTOR MATECO DRILLING CO.
DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 30'
WATER LEVEL AND DATE 2.7'-6/7/83-0715 HRS START 6/2/83 FINISH 6/8/83 LOGGER I.H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6" (N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	90	89.5–91.0	SS-15	18"	16-20-28	SILTY CLAY, BROWN-GRAY, MOIST, VERY STIFF, TRACE SAND AND FINE GRAVEL (cl)		
	92							
	94	94.5–96.0	SS-16	18"	24-42-60	SILTY CLAY, DARK GRAY, MOIST, HARD, TRACE SAND, TRACE FINE GRAVEL (cl)		EASIER DRILLING – FEWER COBBLES NOTICED BELOW 96'
	96							
	98							
	100	95.5–100.0	SS-17	5"	60/5"	CLAYEY SILT, BROWN-GRAY, MOIST, HARD, SOME SAND, TRACE FINE GRAVEL (cl-ml)		ROUGH DRILLING COBBLES BELOW 120'
	102							
	104	104.5–105.5	SS-18	11"	37-60/5"	SILT, DARK GRAY, MOIST, HARD TRACE CLAY, TRACE FINE GRAVEL (ml) ~106.5		
	106							EASIER DRILLING BELOW 106.5'
	108					SAND, FINE, BROWN, WET, DENSE (sp) 110.0		
	110	109.5–111.0	SS-19	18"	39-36-46	SILTY CLAY, BROWN, MOIST TO WET, HARD, TRACE SAND (cl).		
	112							
	114	114.5–115.5	SS-20	11"	38-60/5"	SILT, GRAY, MOIST, HARD, SOME SAND, SOME FINE GRAVEL (ml)		COBBLES AT ~116'
	116							
	118							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-1C	SHEET 5 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTHWEST CORNER

ELEVATION 886.70 DRILLING CONTRACTOR MATECO DRILLING CO

DRILLING METHOD AND EQUIPMENT CME 550 RIG ROTARY WITH BENTONITE MUD BELOW 30'

WATER LEVEL AND DATE ____ START 6/2/83 FINISH 6/8/83 LOGGER I. L. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ ~~(N)~~ Blows PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	120	119.5–120.0	SS-21	4"	60/4"	SILTY CLAY, MOTTLED BROWN AND GRAY, MOIST, HARD, SOME SAND, TRACE FINE GRAVEL (cl)		ROUGH DRILLING BELOW 120'
	122							
	124	124.5–125.0	SS-22	5"	60/5"	CLAYEY SILT, BROWN-GRAY, MOIST, HARD, SOME SAND TRACE FINE GRAVEL (cl-ml)		
	126							
	128							
	130	129.5–130.0	SS-23	2"	60/4"	CLAYEY SILT, DARK GRAY, MOIST HARD, SOME SAND, TRACE FINE GRAVEL (cl-ml)		ROUGH DRILLING ROD CHATTER
	132							
	134	134.5–135.0	SS-24	2"	60/5"	SILT, GRAY, MOIST TO WET, TRACE FINE GRAVEL (ml)		
	136							
	138							
	140	139.5–141.0	SS-25	18"	22-25-31	SILTY CLAY, BLUE-GRAY, MOIST VERY STIFF, TRACE SAND (CL)		EASIER DRILLING BELOW 139'
	142							
	144					145.0'		
	146	144.5–146.0	SS-26	18"	20-40-47	SAND, FINE, WET, DENSE, TRACE SILT (sp)		
	148							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-1C	SHEET 6 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTHWEST CORNER
ELEVATION 886.70 DRILLING CONTRACTOR MATECO DRILLING CO.
DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 30'
WATER LEVEL AND DATE ______ START 6/2/83 FINISH 6/8/83 LOGGER I.H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ ~~(N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	150	149.5 – 150.5	SS-27	11"	54-60/5"	CLAYEY SAND, GRAY, WET, DENSE WITH WEATHERED LIMESTONE FRAGMENTS (SC)		ROD CHATTER AND VERY DIFFICULT DRILLING BELOW 150'
	152							
	154–156	154.5 – 156.0	SS-28	12"	54-40-40	SILTY SAND, FINE TO COARSE, GRAY, WET, DENSE, SOME FINE GRAVEL (SM-SW)		
	158							PROBLEMS WITH HOLE CAVING FROM 157 TO 159'
	160	159.5 – 161.0	SS-29	7"	26-40-69	GRAVEL, FINE TO MEDIUM, GRAY, WET, DENSE, WITH FINE TO COARSE SAND, TRACE SILT (GW-SW)		
	162							PROBLEMS WITH HOLE CAVING
	164					~165.0'		
	166	165.0 – 165.9	SS-30	10"	32-60/5"	SILTY CLAY, GRAY, MOIST, SOFT (cl) TOP OF ROCK AT 166.0'		REAMED HOLE WITH 5¼" ROLLER BIT, THEN SET 4" CASING TO 165'
	168–170	166.0 – 171.0	NX ROCK CORE	4'10"	N.A.	LIMESTONE, LIGHT GRAY TO WHITE, HARD, UNWEATHERED, FRACTURED FROM 168.5-170'		
						BOTTOM OF BORING 171.0'		

REV 11/82 FORM D1586

CH2M HILL	PROJECT NUMBER W65230.C3	BORING NUMBER ECC-2C	SHEET 1 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTH

ELEVATION 886.94 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME-550 RIG, 3¼" I.D. HSA TO 36', ROTARY W/BENTONITE MUD BELOW 3[illegible]

WATER LEVEL AND DATE ______ START 6/13/83 FINISH 6/17/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ ~~(N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0–2		SS-1	18"	7-3-2-3	SILTY CLAY, DARK BROWN, MOIST, SOME SAND, SOME ORGANICS, ROOTS AND GRASS (cl-ol) 1.0'		
	2–4		SS-2	24"	4-6-10-14			
	4–6		SS-3	24"	5-7-10-13	SILTY CLAY, GRAY, MOIST, STIFF, TRACE SAND, TRACE FINE GRAVEL (CL-ML)		
	6–8		SS-4	20"	8-11-10-10			
	8–10		SS-5	18"	4-5-7-9			
	10–12		SS-6	20"	5-6-7-9			
	12–14		SS-7	24"	3-4-6-8			
	14–16		SS-8	19"	3-4-4-8	16.0'		WATER AT 15.0'
	16–18		SS-9	15"	8-9-11-13	SAND, FINE TO COARSE, GRAY, WET, MEDIUM DENSE, GRADES TO FINE GRAVEL (SP)		
	18–20		SS-10	24"	9-9-10-10	20.0'		
	20–22		SS-11	10"	8-9-12-13	SAND, FINE TO COARSE, GRAY, WET, MEDIUM DENSE TO DENSE, SOME FINE GRAVEL (SW)		
	22–24		SS-12	24"	11-11-13-19			
	24–26		SS-13	0"	12-11-10-13			
	26–28		SS-14	7"	10-10-12-17			
	28–30		SS-15	0"	18-17-19-21			

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-2C	SHEET 2 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTH
ELEVATION 886.94 DRILLING CONTRACTOR MATECO DRILLING CO.
DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 36'
WATER LEVEL AND DATE ______ START 6/13/83 FINISH 6/17/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ ~~(N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
						31.5'		
	32		SS-16	24"	27-18-17-22	SILTY SAND, FINE TO COARSE, GRAY, WET, DENSE		
	34		SS-17	15"	20-16-18-26	(SM)		SET 6" CASING TO 34'
	36		SS-18	16"	13-20-17-32	35.5'		SET 4" CASING TO 35'
	38	38.0	SS-19	12"	13-35-50	SILTY CLAY, GRAY, MOIST, VERY STIFF TO HARD, SOME FINE GRAVEL (cl-ml)		SET 4" CASING TO 39' HARD, SLOW DRILLING BELOW 40'
	40	40.0						
	42							
	44	44.5	SS-20	18"	28-46-60	CLAY, GRAY, MOIST, VERY STIFF TO HARD, SOME FINE TO COARSE SAND (CL)		
	46	46.0						
	48							
	50	49.5	SS-21	18"	20-26-39	CLAY, GRAY, MOIST, VERY STIFF TO HARD, SOME FINE TO COARSE SAND (CL)		
	52	51.0						
	54	54.5	SS-22	18"	27-24-23	CLAY, GRAY, MOIST TO WET, STIFF WITH 6" SILTY SAND LENS (cl and sm)		
	56	56.0						
	58					~58'		

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-2C	3 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTH

ELEVATION 886.94 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 36'

WATER LEVEL AND DATE ______ START 6/13/83 FINISH 6/17/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6-6-6 (N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60	59.5–61.0	SS-23	18"	12-16-24	SILT, OLIVE GREEN, MOIST, STIFF, SOME FINE SAND (ml)		
	62							
	64–66	64.5–65.5	SS-24	11"	20-60/5"	SILTY SAND AND SANDY SILT, OLIVE GREEN, MOIST, STIFF TO HARD (sm and ml) ~68'		
	68							
	70	69.5–70.5	SS-25	12"	37-60/5"	SILTY CLAY, OLIVE GREEN, MOIST, VERY STIFF TO HARD (cl)		
	72							
	74–76	74.5–75.5	SS-26	12"	26-60/5"	CLAY, OLIVE GRAY, MOIST, HARD (cl)		
	78							
	80	79.5–80.5	SS-27	12"	50-60/5"	CLAYEY SILT, OLIVE GRAY, MOIST, HARD (ML-CL)		
	82							
	84–86	84.5–85.5	SS-28	11"	38-60/5"	SILTY CLAY, BROWN, DRY TO MOIST (cl)		
	88							

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-2C	SHEET 4 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTH

ELEVATION 886.94 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 36'

WATER LEVEL AND DATE ______ START 6/13/83 FINISH 6/17/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ ~~(N)~~ Blows per 6-inches	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	90	89.5–91.0	SS-29	18"	24-43-60/6"	SILTY CLAY, GRAY, MOIST, HARD, TRACE FINE GRAVEL (cl)		
	92							
	94 / 96	94.5–96.0	SS-30	16"	28-49-60/4"	CLAY, GRAY, MOIST, HARD, SOME SILT (cl) ~98.0'		
	98 / 100	99.5–100.5	SS-31	10"	55-60/5"	SAND, FINE TO COARSE, BROWN, VERY DENSE, TRACE FINE GRAVEL (SP-SM)		SOFTER DRILLING BELOW 98.0'
	102							
	104 / 106	104.5–105.4	SS-32	9"	43-60/3"	SAND, FINE TO MEDIUM, BROWN, VERY DENSE (sp) ~109.0'		
	108 / 110	109.5–111.0	SS-33	18"	20-44-56	SANDY SILT AND SILTY SAND, FINE, GRAY, WET (ml and sm)		
	112					~114.0'		
	114 / 116	114.5–116.0	SS-34	18"	14-28-37	CLAYEY SILT, GRAY, MOIST, VERY STIFF (ml-cl)		HARDER DRILLING BELOW 114.0'
	118							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-2C	SHEET 5 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION NORTH

ELEVATION 886.94 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME-550 RIG, ROTARY WITH BENTONITE MUD BELOW 36'

WATER LEVEL AND DATE ____ START 6/13/83 FINISH 6/17/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	120	119.5–120.9	SS-35	18"	22-44-60/4"	SILTY CLAY, DARK GRAY, MOIST, HARD (CL)		
	124–126	124.5–125.5	SS-36	11"	34-60/5"	CLAY, GRAY, MOIST, HARD, TRACE FINE SAND (ch)		ROD CHATTER DURING DRILLING FROM 126.0' TO 128.0'
	130	129.5–129.9	SS-37	0"	60/5"			
	134–136	134.5–136.0	SS-38	18"	42-56-54	CLAYEY SILT, GRAY, MOIST, HARD TRACE FINE SAND, TRACE ORGANICS (ROOTS) (ml-ol)		
	140	139.5–141.0	SS-39	18"	12-15-21	CLAY, BLUE-GRAY, MOIST, VERY STIFF, TRACE SILT (cl)		
	144–146	144.5–146.0	SS-40	18"	25-17-24	CLAY, GRAY, MOIST, VERY STIFF, SOME FINE TO COARSE SAND (CL-ML)		

Depth scale: 120, 122, 124, 126, 128, 130, 132, 134, 136, 138, 140, 142, 144, 146, 148

CH2M HILL

PROJECT NUMBER: W65230.C3 | **BORING NUMBER:** ECC-2C | SHEET 6 OF 6

SOIL BORING LOG

PROJECT: ECC REMEDIAL INVESTIGATION — LOCATION: NORTH

ELEVATION: 886.94 — DRILLING CONTRACTOR: MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT: CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 36'

WATER LEVEL AND DATE: ______ START: 6/13/83 FINISH: 6/17/83 LOGGER: B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION (NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL)	SYMBOLIC LOG	COMMENTS (DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION)
						~149.0'		
	150	149.5–151.0	SS-41	18"	23-27-32	SAND, FINE TO MEDIUM, GRAY, WET, VERY DENSE, SOME LIMESTONE CHIPS (SM)		
	152							
	154	154.5–154.9	SS-42	0"	60/4"			
	156							
	158							
	160	160.0–160.5	SS-43	4"	60/5"	SAND, FINE TO COARSE, GRAY, WET, VERY DENSE, SOME FINE GRAVEL (SP-GP)		
	162					TOP OF ROCK AT 162.5'		
	164	162.5–165.5	NX ROCK CORE	3'	N.A.	LIMESTONE, LIGHT GRAY TO WHITE, HARD, UNWEATHERED		
						BOTTOM OF BORING 165.7'		
	166							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-3A	SHEET 1 OF 1

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTHEAST CORNER
ELEVATION 876.60 DRILLING CONTRACTOR MATECO DRILLING CO.
DRILLING METHOD AND EQUIPMENT 3¼" I.D. Hollow Stem Augers (CME-45C TRAILER MOUNTED DRILL RIG)
WATER LEVEL AND DATE 6' 6/14/83 - 8:50 AM START 6/14/83 FINISH 6/14/83 LOGGER I.H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ ~~(N)~~ Blows PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0'–2'	X	SS-1	12"	7 4 2 6	SILTY CLAY, BROWN TO BLACK, DRY TO MOIST, STIFF, TRACE ORGANICS (CL)		
	2'–4'	X	SS-2	15"	3 3 4 4			
	4'–6'	X	SS-3	4"	2 4 7 6	6.0'		WATER AT 6.0' NOTED WHILE DRILLING WITH HOLLOW STEM AUGERS
	6'–8'	X	SS-4	12"	3 3 2 2	SAND, FINE TO COARSE, BROWN, WET, LOOSE TO MEDIUM DENSE, SOME SILT, TRACE FINE TO COARSE GRAVEL (SW-SM)		
	8'–10'	X	SS-5	18"	4 6 6 7			
	10'–12'	X	SS-6	24"	3 3 4 5			
	12'–14'	X	SS-7	24"	8 19 15 12			
	14'–16'	X	SS-8	24"	4 11 10 15			
	16'–18'	X	SS-9	20"	13 25 11 7	17.5'		
	18'–20'	X	SS-10	18"	5 7 9 13	SILTY CLAY, GRAY, MOIST, STIFF, TRACE FINE TO COARSE SAND (CL-ML)		
	20'–22'	X	SS-11	20"	5 10 13 19	21.5'		
	22'–24'	X	SS-12	24"	16 23 42 52	SILTY SAND, FINE TO MEDIUM, GRAY, MOIST, DENSE (SM) 23.5'		
	24'					SILTY CLAY, GRAY, MOIST, HARD, SOME SAND, TRACE GRAVEL (CL) 24.0'		

BOTTOM OF BORING AT 24.0'

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230. C3	ECC - 3C	1 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTHEAST

ELEVATION 876.75 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD

WATER LEVEL AND DATE ________ START 6/22/83 FINISH 6/24/83 LOGGER B.N. ZUIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ ~~(N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	2							OFF-SET AND DRILLED WITHOUT SAMPLING TO 23.5' SEE ECC-3A LOG FOR SHALLOW SOIL UNITS
	4							
	6							
	8							
	10							
	12							
	14							
	16							
	18							
	20							
	22							SET 4" CASING TO 23.5'
	24					23.5'		
	26							
	28	27.0 - 28.5	SS-1	0"	17-13-60/5"			
	30							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-3C	SHEET 2 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTHEAST

ELEVATION 876.75 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD

WATER LEVEL AND DATE START 6/22/83 FINISH 6/24/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ Blows per 6-inches	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	32							
	34	34.5						
		34.5–36.0	SS-2	14"	16-41-47	SILTY CLAY, GRAY, MOIST, VERY STIFF TO HARD (CL-ML)		
	36	36.0						
	38	39.5						
	40	39.5–41.0	SS-3	17"	20-22-28	SILTY CLAY, GRAY BROWN, MOIST, VERY STIFF TO HARD (cl-ml)		
	42	41.0						
	44	44.5						
	46	44.5–46.0	SS-4	18"	12-19-26	SILTY CLAY, DARK GRAY, MOIST, VERY STIFF (cl-ml)		
	48	46.0						
	50	49.5–51.0	SS-5	18"	15-17-27	SILTY CLAY, MOTTLED OLIVE GREEN, MOIST, VERY STIFF TO HARD, TRACE SAND (cl-ml)		
	52	51.0						
	54	54.5				55.5'		
	56	54.5–56.0	SS-6	18"	19-35-39	CLAY, OLIVE, MOIST, HARD, TRACE SAND, TRACE GRAVEL (cl)		
	58	56.0						

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-3C	SHEET 3 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTHEAST

ELEVATION 876.75 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD

WATER LEVEL AND DATE ______ START 6/22/83 FINISH 6/24/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6" (N)~~ Blows PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	60	59.5–60.5	SS-7	11"	24-60/5"	CLAY, OLIVE, MOIST TO DRY, HARD, TRACE SILT (cl)		
	62							
	64	64.5–65.9	SS-8	17"	39-48-60/4"	SILTY CLAY, GRAY, MOIST, HARD, SOME FINE TO COARSE SAND, TRACE FINE GRAVEL (CL-ML)		
	66							
	68							
	70	69.5–70.5	SS-9	11"	59-60/5"	SILT, OLIVE GRAY, DRY, HARD, TRACE FINE SAND (ml)		
	72							
	74	74.5–75.5	SS-10	11"	29-60/5"	CLAY, GRAY, DRY, HARD, TRACE SILT, TRACE FINE SAND (cl)		HARD SLOW DRILLING 76.0'- 79.0'
	76							
	78							
	80	79.5–81.0	SS-11	17"	28-37-47	CLAYEY SILT, GRAY, MOIST, HARD, TRACE FINE SAND, TRACE FINE GRAVEL (cl-ml)		
	82							
	84	84.5–86.0	SS-12	18"	42-53-45	CLAYEY SILT, GRAY, MOIST, HARD, GRADES TO SILTY SAND, FINE, GRAY, DENSE, GRADES TO ORGANIC CLAY, BLACK TO DARK GRAY, HIGHLY PLASTIC, SOFT (ml) and (sm) and (ch-oh)		SOFT DRILLING 85-89.5' WOOD AND ORGANICS IN MUD RETURN
	86							
	88							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-3C	SHEET 4 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTHEAST
ELEVATION 876.75 DRILLING CONTRACTOR MATECO DRILLING CO.
DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD
WATER LEVEL AND DATE ______ START 6/22/83 FINISH 6/24/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	90	89.5 – 91.0	SS-13	18"	31-43-44	CLAYEY SILT, GRAY, MOIST, HARD, TRACE FINE GRAVEL, GRADES TO SILTY SAND, FINE, GRAY, WET (ml-sm)		
	92							
	94	94.5 – 95.0	SS-14	5"	60/6"	SANDY SILT, DARK GRAY, MOIST, HARD, TRACE FINE GRAVEL (ml-sm)		
	96							
	98							
	100	99.5 – 100.0	SS-15	0"	60/6"			
	102							
	104	104.5 – 106.0	SS-16	18"	32-48-43	CLAYEY SILT, GRAY, MOIST, HARD, TRACE FINE SAND (ML)		
	106							
	108							SOFTER DRILLING 108.0'-109.5'
	110	109.5 – 109.9	SS-17	5"	120/5"	CLAYEY SILT, GRAY, MOIST, HARD TRACE FINE SAND (ml)		
	112							ROD CHATTER AT ~112'
	114	114.5 – 114.9	SS-18	2"	60/4"	SANDY SILT, GRAY, DRY, HARD, TRACE CLAY, TRACE ORGANICS (ml-sm)		
	116							HARD DRILLING 115.0'-11[illegible].0'
	118							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-3C	5 OF 6

SOIL BORING LOG

PROJECT: ECC REMEDIAL INVESTIGATION LOCATION: SOUTHEAST

ELEVATION: 876.75 DRILLING CONTRACTOR: MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT: CME 550 RIG, ROTARY WITH BENTONITE MUD

WATER LEVEL AND DATE: ____ START: 6/22/83 FINISH: 6/24/83 LOGGER: B.N. ZUILLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	120	119.5–119.9	SS-19	5"	60/5"	SANDY SILT, GRAY, MOIST, HARD, TRACE FINE GRAVEL (ml-sm)		SOFTER DRILLING 119'-124'
	122							
	124	124.5–126.0	SS-20	18"	32-39-51	SILTY CLAY, BROWN, MOIST, HARD, TRACE FINE SAND AND GRAVEL (cl)		SOFT DRILLING 125'-130'
	126							
	128							
	130	129.5–131.0	SS-21	18"	20-24-31	SILTY CLAY, BROWN, MOIST, HARD (CL)		SOFT DRILLING 130'-135'
	132							
	134	134.5–136.0	SS-22	18"	30-28-56	SILTY CLAY, BROWN, MOIST, HARD (cl) 135.5'		
	136					SILTY SAND, FINE TO MEDIUM, GRAY, DENSE (sm)		
	138							
	140	139.5–140.9	SS-23	16"	33-44-60/4"	SAND, FINE, GRAY, MOIST, DENSE GRADES TO A SILTY SAND (sp-sm)		
	142							
	144	144.5–145.0	SS-24	0"	120/6"			HARD, SLOW DRILLING 147'-154'
	146					~147.0'		
	148							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC - 3C	SHEET 6 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTHEAST

ELEVATION 876.75 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD

WATER LEVEL AND DATE ________ START 6/22/83 FINISH 6/24/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	150	149.5 – 151.0	SS-25	18"	30-44-55	CLAY, GRAY-BROWN, MOIST, HARD (cl)		
	152							
	154					BOTTOM OF BORING 154.5		
						~~TOP OF ROCK~~		'NX' CORE BARREL BROKEN - COULD NOT GET WATER CIRCULATION TO CORE ROCK
	156							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-4C	SHEET 1 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION EAST

ELEVATION 884.62 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME-45 TRAILER MOUNTED RIG, 3¼" I.D. HOLLOW STEM AUGERS TO 26'

WATER LEVEL AND DATE 10.0'-6/14/83-1600 HRS START 6/14/83 FINISH 6/21/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6"~~ ~~(N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
		X	SS-1	18"	5-4-4-7	FILL		
	2	X	SS-2	20"	6-4-7-7	4.0'		
	4	X	SS-3	16"	3-4-5-6	SILT, BLACK, SOME ORGANICS, TRACE SAND, MOIST (ml-ol) 5.5'		
	6	X	SS-4	16"	4-5-9-11	CLAYEY SILT, GRAY, MOIST, STIFF, TRACE FINE TO COARSE SAND (ML)		
	8	X	SS-5	18"	7-12-12-10	9.5'		
	10	X	SS-6	13"	10-14-20-18	SAND, FINE TO COARSE, GRAY, SOME CLAY (SC)		WATER AT 10.0'
	12	X	SS-7	12"	25-37-34-33	SAND, FINE TO COARSE, GRAY, SOME CLAY, GRADES TO SILTY SAND (SC)		
	14	X	SS-8	13"	15-22-30-45			
	16	X	SS-9	20"	30-33-40-47	17.0'		
	18	X	SS-10	11"	40-60/5"	SILTY CLAY, GRAY, MOIST, HARD, INTERBEDDED WITH SILTY FINE SAND (CL)		
		18.9						
	20	X	SS-11	24"	25-33-30-32	21.5'		
	22	X	SS-12	20"	18-22-24-32	CLAY, GRAY, MOIST, HARD, SOME FINE TO COARSE SAND (CL)		
	24	X	SS-13	24"	17-23-26-30			
	26							PULLED HOLLOW STEM AUGERS AND SET 4" CASING TO 25' STARTED DRILLING WITH 3¾" ROLLER BIT AND WATER
	28							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-4C	SHEET 2 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION EAST

ELEVATION 884.62 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 45 TRAILER MOUNTED RIG 3 3/4" ROLLER BIT WITH BENTONITE 26'-70.5

WATER LEVEL AND DATE ______ START 6/14/83 FINISH 6/21/83 LOGGER I.H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6" (N)~~ Blows PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	30	29.5–31.0	SS-14	9"	6-26-44	CLAYEY SILT, GRAY, MOIST, HARD, SOME SAND, TRACE GRAVEL (ml-cl)		STARTED USING BENTONITE MUD WITH ROLLER BIT
	32							VERY SLOW DRILLING
	34	34.5–36.0	SS-15	14"	27-46-47	CLAYEY SILT, GRAY, MOIST, HARD, TRACE SAND, TRACE GRAVEL (ml-cl)		
	36							
	38							VERY SLOW DRILLING
	40	39.5–41.0	SS-16	15"	34-50-60/5	CLAY GRAY-BLUE, MOIST, HARD, SOME FINE TO COARSE SAND (CL)		
	42							VERY SLOW DRILLING
	44	44.5–46.0	SS-17	15"	17-27-38	SILTY CLAY, GRAY-BLUE, MOIST, HARD, TRACE SAND, TRACE GRAVEL (cl-ml)		
	46							
	48							VERY SLOW DRILLING
	50	49.5–51.0	SS-18	18"	20-30-40	SILTY CLAY, GRAY-BLUE, MOIST, HARD, TRACE SAND, TRACE GRAVEL (cl-ml) ~52.0'		SWITCHED FROM 3 3/4" ROLLER BIT TO 3 1/2" DRAG BIT TO SPEED UP DRILLING THROUGH THE GLACIAL TILL
	52							
	54	54.5–56.0	SS-19	18"	10-17-23	CLAY, OLIVE GREEN TO GRAY, MOIST, STIFF (CL) ~57.5'		
	56							
	58							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-4C	SHEET 3 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION EAST

ELEVATION 884.62 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME-550 RIG, ROTARY WITH BENTONITE MUD BELOW 70.5'

WATER LEVEL AND DATE ______ START 6/14/83 FINISH 6/21/83 LOGGER I.H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6" (N)~~ Blows per 6-inches	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
		59.5				SAND, FINE, BROWN TO GREEN, MOIST, DENSE (sp)		
	60	59.5–61.0	SS-20	18"	17-23-21	60.5'		
	62	61.0				SILTY CLAY, GRAY, MOIST, HARD (cl)		
	64	64.5				SILTY CLAY, BROWN TO GRAY, MOIST, HARD, WITH FINE SILTY SAND LENSES (cl-ml)		
	66	64.5–65.5	SS-21	11"	25-60/5"			
	68							
	70	69.5–70.5	SS-22	10"	30-60/5"	SAND, FINE, GRAY, MOIST, DENSE, SOME SILT (sp-sm)		STARTED USING CME-550 RIG AT 70.5'
	72							
	74	74.5–75.1	SS-23	8"	50-60/2"	CLAYEY SILT, OLIVE-GRAY, DRY, HARD, TRACE SAND, TRACE GRAVEL (ml-cl)		
	76							BIT CLOGGED
	78							
	80	79.5–79.8	SS-24	0"	60/3"			
	82							
	84	84.5				CLAYEY SILT, GRAY, DRY TO MOIST, HARD, TRACE SAND (ml)		
	86	84.5–85.9	SS-25	12"	37-60/5"			SLOW, HARD DRILLING
	88							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
WG5	ECC-4C	SHEET 4 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION EAST

ELEVATION 884.62 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 70.5'

WATER LEVEL AND DATE ______ START 6/14/83 FINISH 6/21/83 LOGGER B.N. ZUIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6" (N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	90	89.5 – 90.6	SS-26	14"	49-28-60/2"	SILTY CLAY, GRAY, MOIST, HARD, GRADES TO SILTY FINE SAND (cl-ml)		
	92							
	94–96	94.5 – 95.9	SS-27	17"	49-53-60/5"	CLAYEY SILT, GRAY, MOIST, HARD (ML)		
	98							
	100	99.5 – 100.0	SS-28	6"	60/6"	SANDY CLAY, DARK GRAY, MOIST, HARD, SOME SILT (SC)		
	102							SLOW, HARD DRILLING 102.0' – 104.0'
	104–106	104.5 – 105.9	SS-29	16"	31-33-60/4"	SILTY CLAY, GRAY, MOIST, HARD, TRACE FINE SAND (cl)		
	108							
	110	109.5 – 109.9	SS-30	0"	60/5"			
	112							
	114–116	114.5 – 115.5	SS-31	11"	41-60/5"	SANDY SILT, GRAY, MOIST, DENSE (ml-sm)		
	118							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-4C	SHEET 5 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION EAST

ELEVATION 884.62 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 70.5'

WATER LEVEL AND DATE _____ START 6/14/83 FINISH 6/21/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6" (N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	120	119.5 – 119.8	SS-32	3"	60/3"	SILTY SAND, FINE, GRAY, MOIST, VERY DENSE, SOME CLAY (SM)		
	122							
	124	124.5 – 124.9	SS-33	3"	60/3"	SILTY SAND, FINE, GRAY, MOIST, VERY DENSE (SM)		
	126							
	128							
	130	129.5 – 129.9	SS-34	1"	60/4"	SANDY SILT, BROWN-GRAY, MOIST, VERY DENSE, TRACE CLAY (ML)		
	132							HARD DRILLING 130.0' TO 135.0'
	134	134.5 – 136.0	SS-35	18"	27-36-48	SILTY CLAY, GRAY, MOIST, HARD (CL)		
	136							
	138							
	140	139.5 – 141.0	SS-36	18"	22-26-31	SILTY CLAY, BROWN, MOIST, HARD, SOME SAND (CL)		
	142							
	144	144.5 – 145.9	SS-37	17"	34-54-60/5"	SILTY CLAY, BROWN, MOIST, HARD, SOME SAND, OCCAS. SAND LENSES (CL)		
	146							
	148							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-4C	SHEET 6 OF 6

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION EAST

ELEVATION 884.62 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, ROTARY WITH BENTONITE MUD BELOW 70.5'

WATER LEVEL AND DATE ______ START 6/14/83 FINISH 6/21/83 LOGGER B.N. ZUIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS ~~6"-6"-6" (N)~~ BLOWS PER 6-INCHES	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
						~149.0'		
	150	149.5–150.9	SS-38	12"	31-47-60/5"	SAND, FINE, GRAY, WET, VERY DENSE, SOME SILT (SM)		
	152							
	154	154.5–155.5	SS-39	8"	53-60/5"	SAND, FINE TO COARSE, GRAY, WET, VERY DENSE, TRACE SILT (SM)		
	156							
	158							
	160					CLAY, LIGHT GRAY, MOIST, HARD		SLOW DRILLING 160-162'
		161.0–161.9	SS-40	10"	34-60/4"	TOP OF ROCK 161.9'		
	162							
	164	162.9–165.9	NX ROCK CORE	3.0'	N.A.	LIMESTONE, LIGHT GRAY TO WHITE, HARD, UNWEATHERED		
						BOTTOM OF BORING 165.9'		
	166							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-5A	SHEET 1 OF 2

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTHWEST

ELEVATION 887.28 DRILLING CONTRACTOR MATECO DRILLING

DRILLING METHOD AND EQUIPMENT CME 550 RIG, 3¾" HOLLOW STEM AUGERS

WATER LEVEL AND DATE 10.0' - 6/24/83 START 6/24/83 FINISH 6/24/83 LOGGER B.N. ZVIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	2							
	4	4.5						
	6	4.5–6.5	SS-1	24"	5-7-9-13	SILTY CLAY, MOTTLED BROWN AND GRAY, MOIST, VERY STIFF, TRACE OF ROOTS, TRACE GRAVEL (CL-ML)		
	8							
	10	9.5–11.5	SS-2	18"	7-4-4-4	SILTY CLAY, GRAY, WET, MEDIUM STIFF, WITH INTERBEDDED SILTY SAND AND SANDY SILT (cl-ml)		WATER AT 10' NOTED WHILE DRILLING WITH HOLLOW STEM AUGERS
	12							
	14							
	16	14.5–16.5	SS-3	17"	5-6-7-9	CLAYEY SILT, GRAY, WET, STIFF, TRACE SAND (ml) ~18.0'		
	18							
	20	19.5–21.5	SS-4	16"	6-6-6-8	SAND, FINE TO COARSE, GRAY, WET, MEDIUM DENSE, SOME FINE GRAVEL (SW)		
	22							HARDER DRILLING BELOW 22'
	24							
	26	24.5–26.5	SS-5	0"	12-15-19-19			
	28							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	
W65230.C3	ECC-5A	SHEET 2 OF 2

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTHWEST

ELEVATION 887.28 DRILLING CONTRACTOR MATECO DRILLING CO.

DRILLING METHOD AND EQUIPMENT CME 550 RIG, 3¾" I.D. HOLLOW STEM AUGER

WATER LEVEL AND DATE ______ START 6/24/83 FINISH 6/24/83 LOGGER B.N. ZUIBLEMAN

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
		29.5						
	30		SS-6	22"	13-20-27-30	SAND, FINE TO COARSE, GRAY, WET, VERY DENSE, GRADES TO FINE SILTY SAND (SW-SM)		
	32	31.5				BOTTOM OF BORING AT 31.5'		

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER: W65230.C3

BORING NUMBER: ECC-6A

SHEET 1 OF 1

SOIL BORING LOG

PROJECT: ECC REMEDIAL INVESTIGATION LOCATION: NORTHEAST

ELEVATION: DRILLING CONTRACTOR: ATEC, ASSOC.

DRILLING METHOD AND EQUIPMENT: 3¼" I.D. HSA's TO 28.5' 6¼" I.D. HSA's TO 23.0'

WATER LEVEL AND DATE: 8.5' – 09:25 HRS 9/1/83 START: 0815 - 9/1/83 FINISH: 1735 - 9/1/83 LOGGER: J. W. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
								START 0815 HRS STARTED SAMPLING AT 5' BELOW GROUND SURFACE
	5.0	X	SS-1	18"	2-4-6	CLAYEY SILT, MOTTLED BROWN, MOIST, STIFF, 10% FINE SAND (ML-CL)		
		X	SS-2	18"	8-11-12	8.0'		
		X	SS-3	18"	5-6-8	SILTY CLAY, GRAY, MOIST, STIFF, 10% FINE TO MED. SAND (CL)		
	10.0	X	SS-4	18"	4-5-7			
		X	SS-5	12"	4-5-8			
		X	SS-6	18"	10-11-11	13.5'		Water Noted at 13.5' on SS-6 (09:20 HRS)
	15	X	SS-7	18"	2-2-2	SAND, FINE TO COARSE, GRAY, WET, MED. DENSE TO DENSE, ~10% FINE GRAVEL, (SP)		Water Noted at 8.5' on AW-RODS (09:25 HRS)
		X	SS-8	18"	7-7-10			
		X	SS-9	18"	8-22-48			
		X	SS-10	6"	9-15-20			
	20							
		23.5 X	SS-11	18"	15-27-21	24.5		
	25	25.0				SILTY CLAY, GRAY, MOIST, HARD, 10% SAND, (CL-ML)		
		28.5 X	SS-12	12"	33-50-63	BOTTOM OF BORING 30.0		NO HNU READINGS ABOVE BACKGROUND
	30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-7A	1 OF 1

SOIL BORING LOG

PROJECT ECC REMEDIAL INVESTIGATION LOCATION SOUTH OF ECC-4

ELEVATION ______ DRILLING CONTRACTOR ATEC, ASSOC.

DRILLING METHOD AND EQUIPMENT 3¼ HSA's TO 29.5 FT. BELOW GROUND SURFACE

WATER LEVEL AND DATE 12.5 FT - 9/1/83 START 9/1/83-1630 FINISH 9/1/83-1810hrs LOGGER I. H. JOHNSON

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
						FILL, SAND, SILT, CLAY, MOTTLED BROWN, SOME TRASH 4.0'		DRILLED TO 5.0 FT TO START SPLIT-SPOON SAMPLING
	5					SILTY, CLAY, MOTTLED GREEN, MOIST, STIFF, (CL) 6.5'		
		X	SS-1	10"	2-5-9			
		X	SS-2	12"	10-13-14	CLAYEY SILT, GRAY, MOIST, STIFF, STIFF TO HARD, (CL-ML)		
		X	SS-3	12"	13-16-21			
	10	X	SS-4	9"	16-19-20			
		X	SS-5	11"	17-30-28	12.0'		
		X	SS-6	16"	12-17-18	SILTY SAND, FINE, GRAY, WET, DENSE, (SM) 13.0'		
	15	X	SS-7	18"	11-20-27	CLAYEY SILT, GRAY, MOIST, HARD, WITH INTERBEDDED, SILTY SAND, FINE, GRAY, MOIST TO WET, DENSE (ML-CL) AND (SM)		WATER NOTED AT 15.5' ON RODS
		X	SS-8	18"	18-19-35			
		X	SS-9	18"	4-28-46			
		X	SS-10	14"	20-29-21			
	20							
		X	SS-11	18"	17-30-39	CLAYEY SILT, GRAY, MOIST, HARD, ~10 TO 15% SAND, (ML-CL)		
	25							NO HNu READINGS ABOVE BACKGROUND
						SILTY SAND, FINE, GRAY, WET, (SM)		WATER AT 12.5 FT. AT COMPLETION
		X	SS-12	9"	49-65/6"	BOTTOM OF BORING 29.5'		
	30							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-9A	SHEET 1 OF 1

SOIL BORING LOG

PROJECT ECC RI LOCATION Southwest of SW Corner of Site

ELEVATION ______ DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT Mobil B-61 Rig, 4" I.D. HSA's and 6" I.D. HSA's

WATER LEVEL AND DATE ______ START 10/31/84 FINISH 11/2/84 LOGGER I. H. Johnson

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	2							HNu reading background (~0.5ppm)
	4							
	6							
	8							
	8–10	X	SS-1	18"	6-11-18	Silty Clay, Gray, Stiff, moist some sand and fine gravel.		
	12							
	14–15	X	SS-2	0"	7-11-17	Silty Clay, Gray, stiff, moist some sand and fine gravel		
	16							
	18					~18'		
	18.5–20	X	SS-3	12"	4-4-12	Sand and Gravel, Fine to Coarse, Gray, wet		Sand flowed into bottom of HSA's to 6' B.G.S. after driving SS-3. Had to ream borehole with 6" I.D. HSA's and added water to set well pipe and screen.
	22							
	24					Bottom of Boring 25'		
	26							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-8A	1 OF 1

SOIL BORING LOG

PROJECT ECC RI LOCATION NE Corner of Concrete Pad

ELEVATION ______ DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT Mobil B-61 Rig, 4" I.D. HSA's

WATER LEVEL AND DATE ______ START 10/26/84 FINISH 10/26/84 LOGGER I. H. Johnson

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	2							HNu reading background (~0.5ppm)
	4	X	SS-1	14"	3-4-4	Silty Clay, Brown to Gray, Stiff, some sand, blocky texture, moist		
	6				?			
	8				?			
	10	X	SS-2	9"	4-6-7	Sand, Gray, Fine to Medium, wet		
	12				?			
	14	X	SS-3	2"	8-12-12	Silty Clay, Gray, moist to wet		
	16							
	18					~18'		
	20	X	SS-4	16"	10-13-12	Sand, Fine to Coarse, some Fine gravel, wet		Flowing sand below 20'
	22							
	24					Bottom of Boring @ 25'		
	26							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-11A	1 OF 1

SOIL BORING LOG

PROJECT ECC RI LOCATION SW Entrance to Site

ELEVATION DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT Mobil B-61, 4" I.D. HSA's

WATER LEVEL AND DATE START 11/5/84 FINISH 11/5/84 LOGGER I.H. Johnson

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	2							HNu reading background (~ 0ppm)
	4							
	6							
	8							
	10		SS-1	4"	8-6-10	Silty Clay, Brown, some fine sand and gravel, wet		HNu reading ~60ppm in HSA
	12							
	14		SS-2	16"	5-5-7	Silty Clay, Gray, some sand and gravel, moist. BOTTOM OF BORING 15.0'		HNu reading at ~60ppm Decided to set well screen from 10' to 15' B.G.S. because of high HNu readings
	16							

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	ECC-10A	1 OF 1

SOIL BORING LOG

PROJECT ECC RI LOCATION SOUTH OF FENCE ALONG ROAD

ELEVATION ______ DRILLING CONTRACTOR ATEC

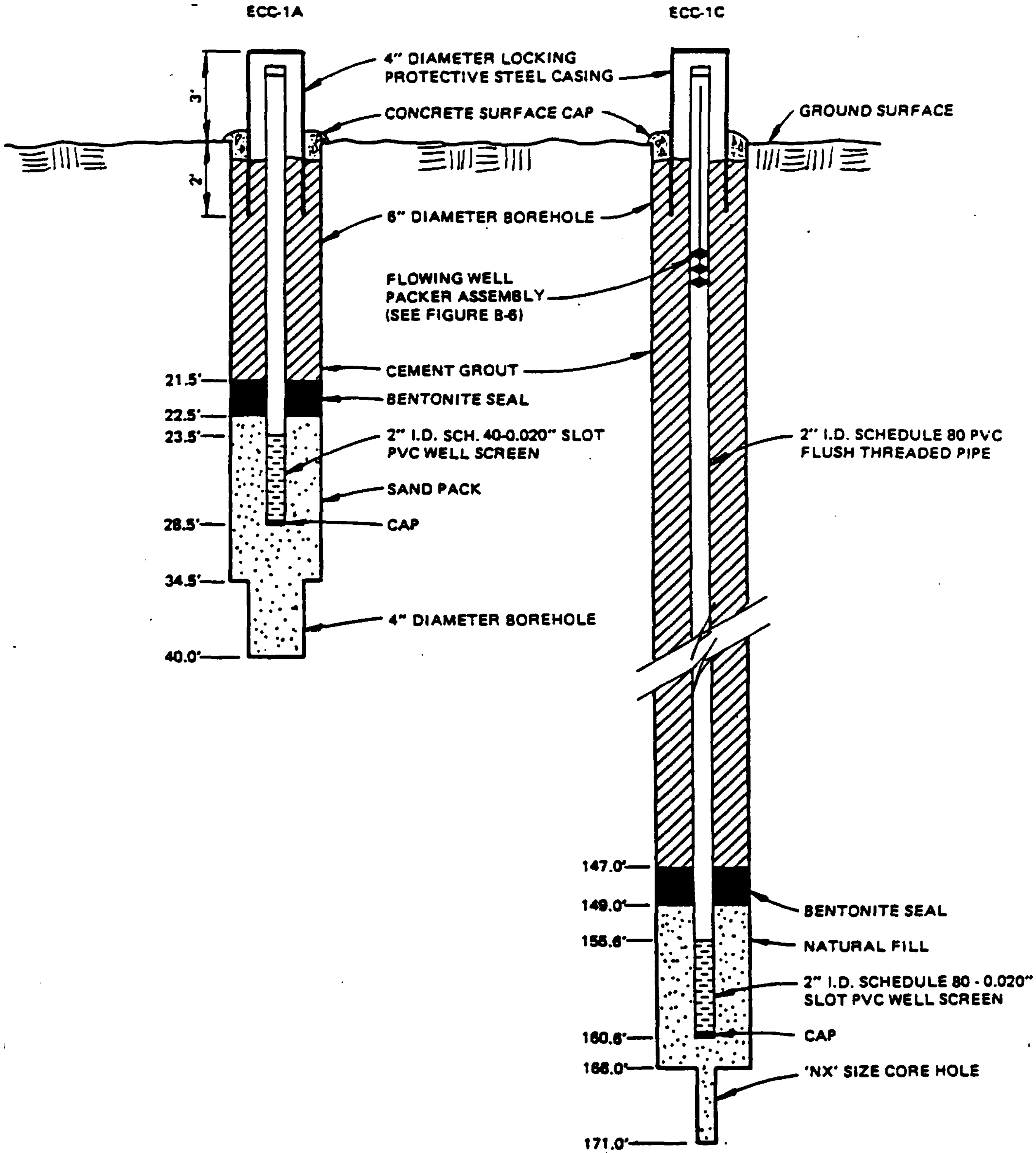
DRILLING METHOD AND EQUIPMENT Mobil B-61 Drill Rig, 4" I.D. HSAs

WATER LEVEL AND DATE ______ START 11/2/84 FINISH 11/2/84 LOGGER I.H. Johnson

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	2							HNu reading background (~0.5ppm)
	4							
	6							
	8							
	10		SS-1	12"	4-10-16	Silty Clay, Dark Gray, some sand and fine gravel, Silty Sand, Bottom 4" of Sample, moist to wet ~10.5'		
	12							
	14		SS-2	4"	22-47-50/3"	Sand, Light Brown, Fine, Some Silt, wet		
	16					~16.5'		Rod Chatter, possible cobbles and coarse gravel at 15 ft.
	18							
	20		SS-3	9"	8-13-14	Silty Clay, Dark Gray, some sand and fine gravel, moist		
	22							
	24		SS-4	14"	11-26-38	Silty Clay and Clayey Silt, Gray, Hard, moist, some sand and gravel. Bottom of Boring @ 25.0'		
	26							

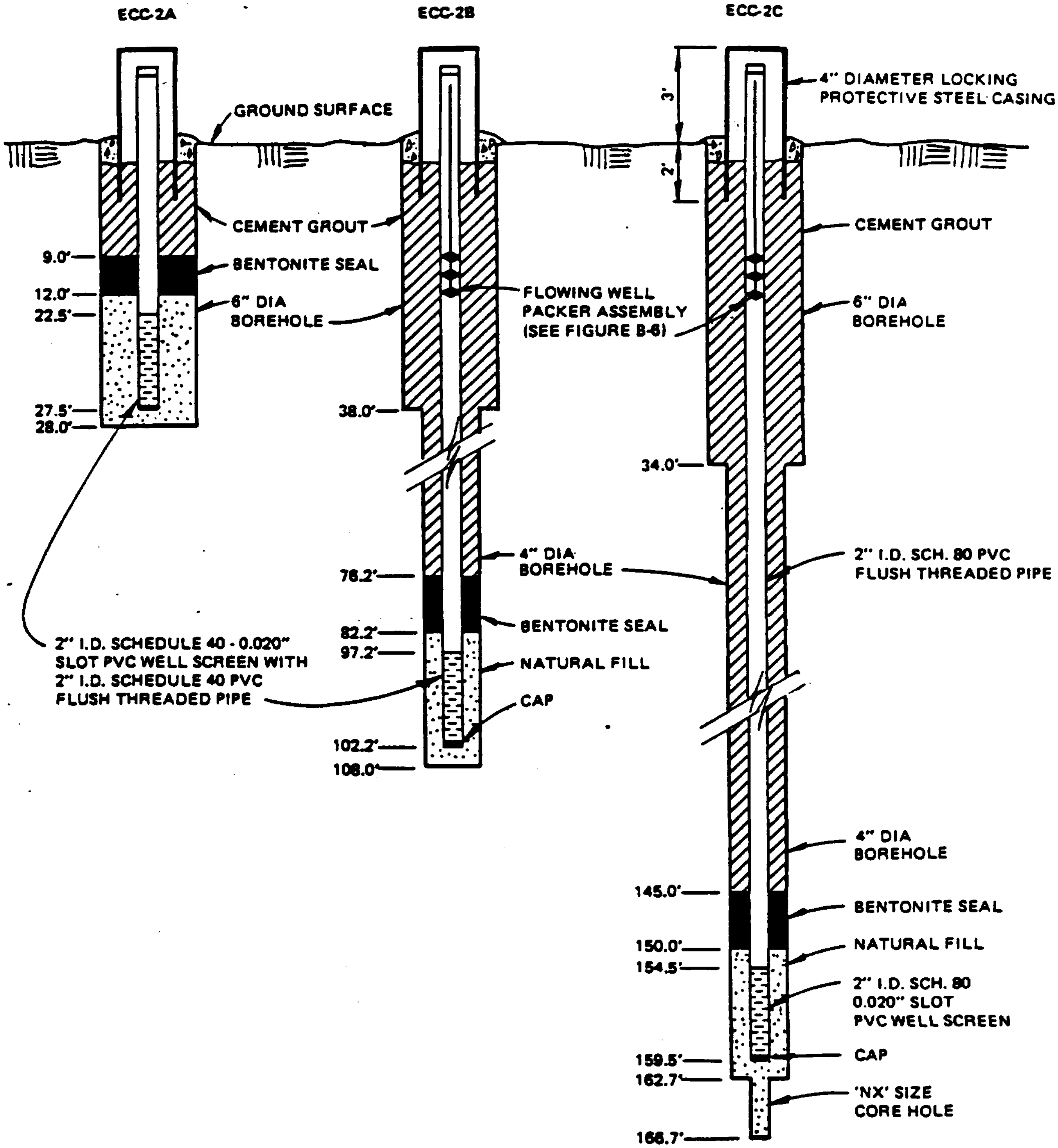
TECHNICAL MEMORANDUM
Subtask 3-1

Appendix C
MONITORING WELL CONSTRUCTION DETAILS



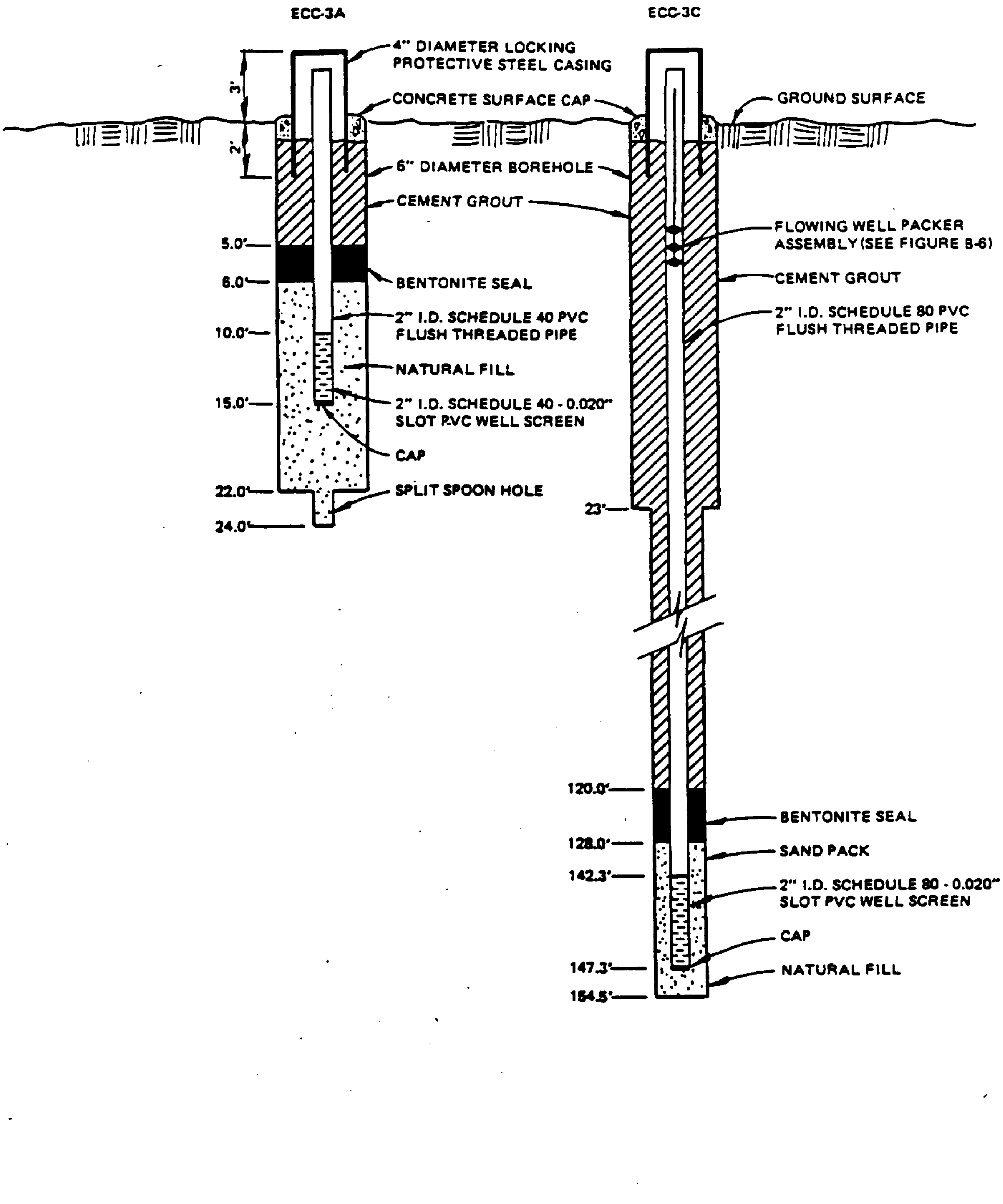
NOTE: Figure not drawn to scale

FIGURE B-1
MONITORING WELL CONSTRUCTION
ECC-1 CLUSTER
TM 3-1



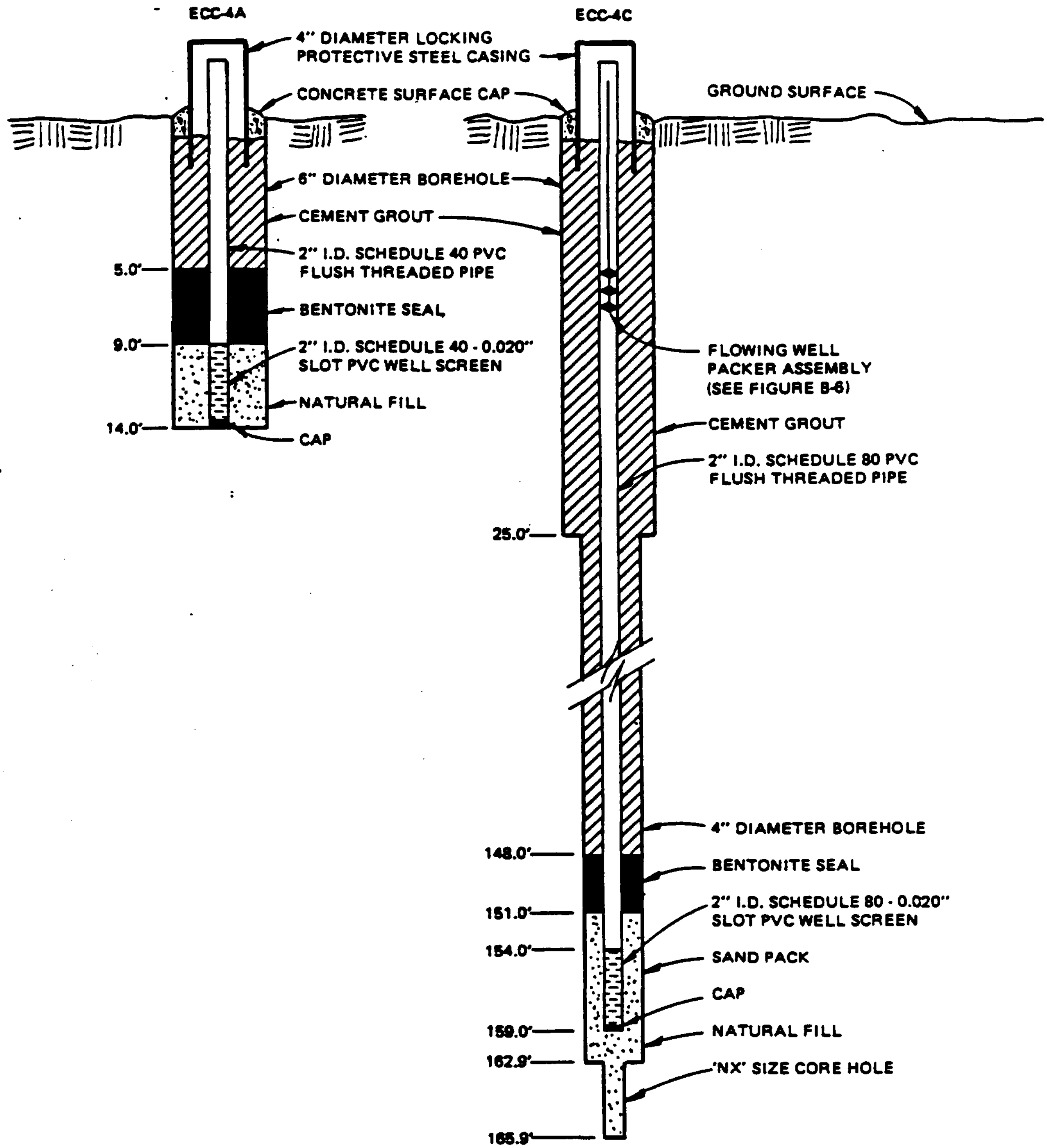
NOTE: Figure not drawn to scale

FIGURE B-2
MONITORING WELL CONSTRUCTION
ECC-2 CLUSTER
TM 3-1



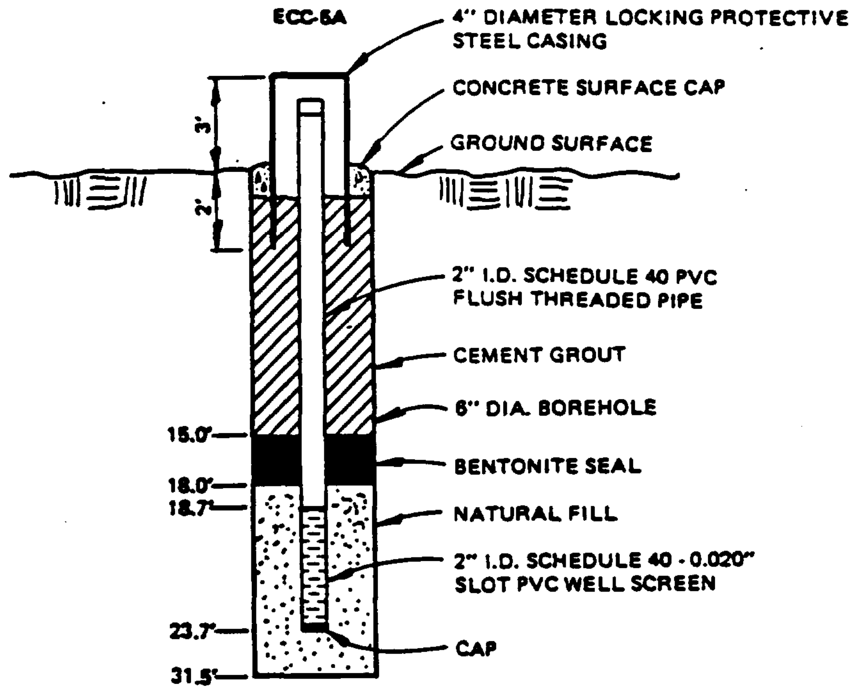
NOTE: Figure not drawn to scale

FIGURE B-3
MONITORING WELL CONSTRUCTION
ECC-3 CLUSTER
TM 3-1



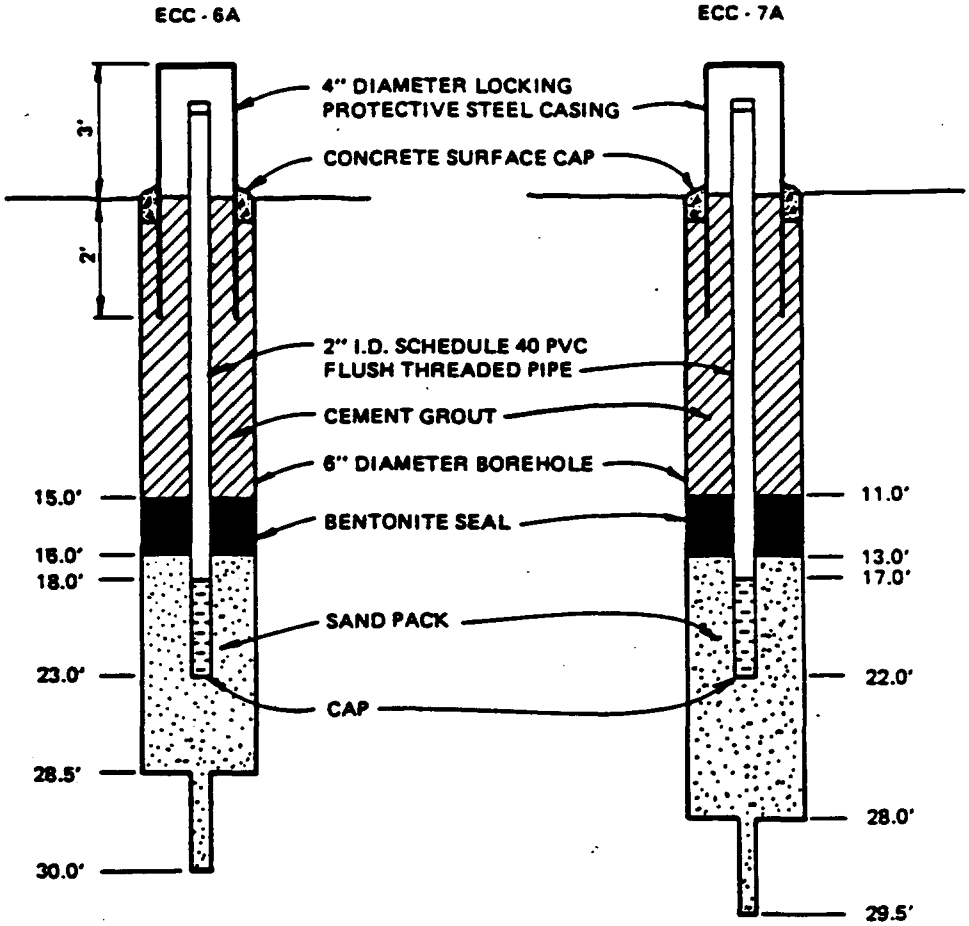
NOTE: Figure not drawn to scale

FIGURE B-4
MONITORING WELL CONSTRUCTION
ECC-4 CLUSTER
TM 3-1



NOTE: Figure not drawn to scale

FIGURE B-5
MONITORING WELL CONSTRUCTION
ECC-5A
TM 3-1



NOTE: Figure not to scale.

FIGURE B-6
MONITORING WELL CONSTRUCTION
ECC - 6A AND ECC - 7A
ECC SITE
TM 3-1

TECHNICAL MEMORANDUM
Subtask 3-1

Appendix D
LABORATORY SOIL CLASSIFICATION TEST RESULTS

LABORATORY TESTING PROCEDURES

Grain Size Tests

Grain size tests were performed to determine the particle size and distribution of the samples tested. The grain size distribution of soils coarser than a No. 200 sieve was determined by passing the sample through a standard set of nested sieves. These tests are similar to those described by ASTM D-421 and D-422. The results are presented on the attached Grain Size Distribution Sheets.

Moisture Content

The moisture content is the ratio expressed as a percentage of the weight of water in a given mass of soil to the weight of the solid particles. This test was conducted in accordance with ASTM Designation D-2216-66. The results of these tests are presented on the attached Summary of Laboratory Test Data.

Specific Gravity of Soil Solids

The specific gravity of soil solids is the ratio of the weight in air of a given volume of soil particles to the weight in air of an equal volume of water. This test was conducted on selected soil samples in accordance with ASTM designation D-854-58. The results of these tests are presented on the attached Summary of Laboratory Data.

Atterberg Limits Testing

Representatiave samples of the soils were selected for Atterberg Limits testing to determine the soil plasticity characteristics. The soil's Plastic Index (PI) is representative of this characteristic and is bracketed by the Liquid Limit (LL) and the Plastic Limit (PL). The LL is the moisture content at which the soil will flow as a heavy viscous fluid and is determined in accordance with ASTM D-423. The PL is the moisture content at which the soil begins to lose its plasticity and is determined in accordance with ASTM D-424. The data obtained are presented on the attached Summary of Laboratory Test Data and boring logs.

BORING LOG TERMINOLOGY

Permit Number:	This mineral Well Permit Number is assigned to Materials Testing Consultants, by the State of Michigan Department of Natural Resources Geological Survey Division. Materials Testing Consultants is obligated under the rules of the Mineral Well Act to plug test borings in a specified manner.
Sample Type:	"SBS" and "L" are the split barrel and liner samplers used to recover soil samples in the ASTM D 1586 Standard Penetration Test.
	"S.T." refers to the thin-walled sampler (Shelby Tube) used to recover relatively undistrubed soil samples in the ASTM D 1587 method of sampling.
	"A" refers to a distrubed auger sample.
	"C" refers to a rock core sample obtained by Diamond Core Drilling in accordance with ASTM D 2113.
Boring Method:	"H.S.A." refer to the Hollow Stem Auger.
	"S.S.A." refers to the Solid Stem Auger.
	"W" refers to the Wash Boring Method.
	"R" refers to the Rotary Method.
	"C" refers to the Casing Method.
Water Observations:	Depth of water is measured from the top of ground to top of water level. Initial depth indicates water encountered during boring, completion depth indicates water level immediately after boring, and depth after "X" number hours indicates water level after a time period.
	Water observations in pervious soils are considered reliable groundwater levels for that date. Water observations in impervious soils may not be accurate groundwater measurements unless records are made over several days' time. The groundwater level will fluctuate for both pervious and impervious soils.
Soils Description:	Visual classification of major soil constituents.

Color:	When the color of the soil is uniform throughout, a single color such as brown, gray or black will be used, modified by adjective such as light and dark. If the soil's predominant color is shaded by a secondary color, the secondary color precedes the primary color, such as: gray-brown, yellow-brown. If two major and distinct colors are swirled throughout the soil, the colors will be described by the term mottled, such as: Mottled brown and gray.	
Size:	<u>Soil Components</u>	<u>Size</u>
	Boulders	Larger than 8"
	Cobbles	8" to 3"
	Gravel--Coarse	3" to 3/4"
	--Fine	2 mm. to 3/4"
	Sand --Coarse	2 mm. to 0.6 mm.
	--Medium	0.6 mm.-0.2 mm.
	--Fine	0.2 mm.-0.06 mm.
	Silt	0.06 mm.-0.002 mm.
	Clay	0.002 mm and smaller
Minor Component Quantifying Term:	Trace 1-10%	(Percentages are estimates unless a sieve analysis is performed
	Little 10-20%	
	Some 20-35%	
	And 35-50%	
Layer or Stratum:	Soil mass which can be characterized, for engineering purposes, by a single set of strength and classification parameters.	
Lenses:	Lenses of soil occur within a soil layer and range in thickness from a fraction of an inch to approximately one (1) foot thick.	
Seams:	Planer opening in a soil layer filled with soils of different characteristics. Soil seams are usually a fraction of an inch thick and may occur in various directions.	

Density:
Granular Soils (Cohesionless)

Number of Blows	Relative Density	Compactness
0-4	0-20%	Very Loose
5-10	20-40%	Loose
11-30	40-70%	Medium Dense
31-50	70-90%	Dense
above 50	90-100%	Very Dense

Consistency:
Cohesive Soils

Number of Blows	Approximate Shear Strength in K.S.F.	Cohesion
0-2	0.25	Very Soft
3-4	0.25-0.5	Soft
5-8	0.5-1	Medium Stiff
9-16	1-2	Stiff
17-32	2-4	Very Stiff
above 32	above 4	Hard

Grading: When Soil characteristics vary gradually with depth within the same soil stratum, the variation is described by using the term "grading".

N.P.M.: Natural Percent Moisture of in situ soil sample.

N.D.: Natural Density of in situ soil sample in p.c.f.

S.S.: Shear Stength of cohesive soil samples as determined by the Unconfined Compression Tests in K.S.F.

Classification Data: Laboratory data to assist in classification of soils and classification of soil characteristics. ie: Plastic Limit, Liquid Limit.

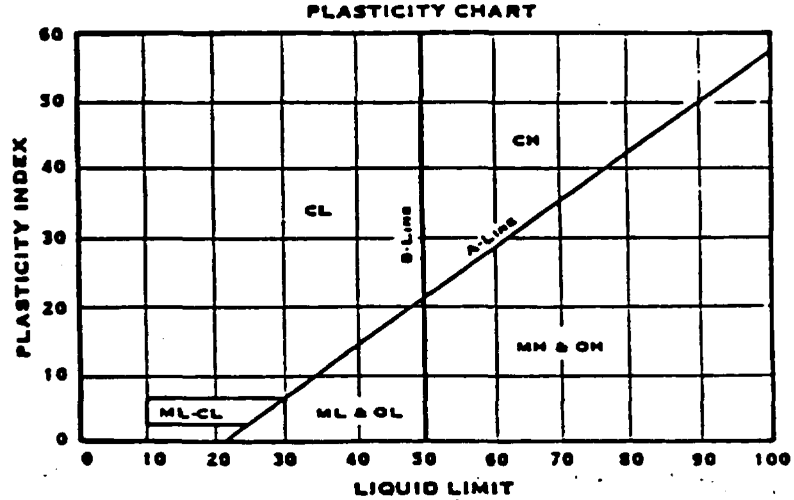
MATERIALS TESTING CONSULTANTS INC.

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)	GW	Well-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
			GP	Poorly-Graded Gravels, Gravel-Sand Mixtures, Little or No Fines
		GRAVELS WITH FINES (APPRECIABLE AMT. OF FINES)	GM	Silty Gravels, Gravel-Sandy-Silt Mixtures
			GC	Clayey Gravels, Gravel-Sand-Clay Mixtures
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)	SW	Well-Graded Sands, Gravelly Sands, Little or No Fines
			SP	Poorly-Graded Sands, Gravelly Sands, Little or No Fines
		SANDS WITH FINES (APPRECIABLE AMT. OF FINES)	SM	Silty Sands, Sand-Silt Mixtures
			SC	Clayey Sands, Sand-Clay Mixtures
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50	ML	Inorganic Silts & Very Fine Sands, Rock Flour, Silty or Clayey Fine Sands or Clayey Silts with Slight Plasticity
			CL	Inorganic Clays of Low to Medium Plasticity, Gravelly Clays, Sandy Clays, Silty Clays, Lean Clays
			OL	Organic Silts and Organic Silty Clays of Low Plasticity
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50	MH	Inorganic Silts, Micaceous or Diatomaceous Fine Sand or Silty Soils
			CH	Inorganic Clays of High Plasticity, Fat Clays
			OH	Organic Clays of Medium to High Plasticity, Organic Silts
	HIGHLY ORGANIC SOILS		PT	Peat, Humus, Swamp Soils with High Organic Contents

FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

PLASTICITY CHART



SUMMARY OF LABORATORY TEST DATA

Boring Number	Sample Depth	Sample Type**	Sample Description and USCS Classification	Unit Weight pcf		Unconfined Compressive Strength KSF	Percent Finer No. 200 Sieve	Specific Gravity	Natural Moisture Content	Atterberg Limits			MTCI Sample Number	
				Wet	Dry					L.L.	P.L.	P.I.		
1A	2-4'	SS 2	gray silty clay (CL)						11.4	20.9	13.5	7.4	92921	
1A	4-6'	SS 3	gray clay with f-c sand and f gravel (CL)				58.8	2.68					92899	*
1A	14-16'	SS 8	gray silty clay (CL-ML)						9.4	16.9	11.4	5.5	92922	
1A	18-20'	SS 10	gray silty clay (CL-ML)						5.3	15.0	10.8	4.2	92923	
1A	28-30'	SS 12	brown & gray mottled silty clay (CL-ML)						7.0	18.0	12.5	5.5	92924	
1A	34½-36'	SS 13	gray clay with f to c sand and f gravel (CL)				56.6	2.68					92900	*
1C	23½-25'	SS 1	gray fine to c sand with some f gravel (SW)				6.0						92901	*
1C	29½-31'	SS 2	gray fine sand with some silt (SM)				34.6	2.670					92902	*
1C	34½-36'	SS 3	gray silty clay with f-c sand & f gravel(CL-ML)						5.7	22.6	18.3	4.3	92925	
1C	39½-41'	SS 4	gray clay with f-c sand & f gravel (CL)				65.5	2.70					92903	*

* Graphic Presentations of Results of Triaxial, Consolidation, CBR, Proctor, Grain Size, and other tests follow this summary

** SS - Split Spoon Sample (ASTM D 1586)
UD - Undisturbed Sample (ASTM D 1587)

Materials Testing Consultants, Inc.

JOB NUMBER: 162G

SUMMARY OF LABORATORY TEST DATA

Boring Number	Sample Depth	Sample Type**	Sample Description and USCS Classification	Unit Weight pcf		Unconfined Compressive Strength KSF	Percent Finer No. 200 Sieve	Specific Gravity	Natural Moisture Content	Atterberg Limits			MTCI Sample Number	
				Wet	Dry					L.L.	P.L.	P.I.		
1C	54½-56'	SS 7	brown & gray mottled clay (CL)						10.5	40.8	21.9	18.9	92926	
1C	64½-65½'	SS 10	gray silty clay with some f-c sand (CL)						5.9	16.2	11.8	4.4	92927	
1C	74½-76'	SS 12	brown silt with f-c sand & f gravel (ML)				58.3	2.68					92904	*
1C	79½-80½'	SS 13	brown silt with f-c sand and f gravel (ML)						6.0	15.6	11.9	3.7	92928	
1C	139½-141'	SS 25	blue gray silty clay (CL)						15.2	47.5	19.4	28.1	92929	
1C	154½-156'	SS 28	gray silty f-c sand with some f gravel (SM-SW)				11.5						92905	*
2C	4-6'	SS 3	gray silty clay with some fine gravel (CL-ML)						7.5	17.7	11.3	6.4	92930	
2C	12-14'	SS 7	gray silty clay (CL-ML)						7.8	16.3	10.9	5.4	92931	
2C	16-18'	SS 9	gray f-c sand (SP)				5.8						92906	*
2C	20-22'	SS 11	gray f-c sand with some fine gravel (SW)				4.9						92907	*

* Graphic Presentations of Results of Triaxial, Consolidation, CBR, Proctor, Grain Size, and other tests follow this summary

** SS = Split Spoon Sample (ASTM D 1586)
UD = Undisturbed Sample (ASTM D 1587)

Materials Testing Consultants, Inc.

JOB NUMBER: 162G

SUMMARY OF LABORATORY TEST DATA

Boring Number	Sample Depth	Sample Type**	Sample Description and USCS Classification	Unit Weight pcf Wet	Unit Weight pcf Dry	Unconfined Compressive Strength KSF	Percent Finer No. 200 Sieve	Specific Gravity	Natural Moisture Content	Atterberg Limits L.L.	Atterberg Limits P.L.	Atterberg Limits P.I.	MTCI Sample Number	
2C	26-28'	SS 14	gray f-c sand with some f gravel (SW)				2.3						92965	*
2C	32-34'	SS 17	gray f-c sand with some silt (SM)				33.9						92908	*
2C	44½-46'	SS 20	gray clay with some f-c sand (CL)						2.9	23.9	12.5	11.4	92932	
2C	49½-51'	SS 21	gray clay with some f-c sand (CL)				67.6	2.699					92909	*
2C	79½-80½'	SS 27	gray clayey silt (CL-ML)						8.0	19.5	13.1	6.4	92933	
2C	99½-100½'	SS 31	brown f-c sand with little gravel (SP-SM)				10.0						92910	*
2C	119½-121'	SS 35	gray silty clay (CL)						10.5	22.2	14.7	7.5	92934	
2C	144½-146'	SS 40	gray clay with some f-c sand (ML-CL)						15.8	21.1	14.3	6.8	92935	
2C	149½-151'	SS 41	gray f-m sand with limestone (SM) chips & little silt				13.9						92911	*
3A	2-4'	SS 2	brown clay fill (CL)						12.7	26.4	16.5	9.9	92936	

* Graphic Presentations of Results of Triaxial, Consolidation, CBR, Proctor, Grain Size, and other tests follow this summary

** SS = Split Spoon Sample (ASTM D 1586)
UD = Undisturbed Sample (ASTM D 1587)

Materials Testing Consultants, Inc.

JOB NUMBER: 162G

SUMMARY OF LABORATORY TEST DATA

Boring Number	Sample Depth	Sample Type**	Sample Description and USCS Classification	Unit Weight pcf		Unconfined Compressive Strength KSF	Percent Finer No. 200 Sieve	Specific Gravity	Natural Moisture Content	Atterberg Limits			MTCI Sample Number	
				Wet	Dry					L.L.	P.L.	P.I.		
3A	8-10'	SS 5	brown f-c sand with little silt (SM-SW)				11.1						92912	*
3A	14-16'	SS 8	brown f-c sand with little f-c gravel & silt (SM)				15.4						92913	*
3A	18-20'	SS 10	gray silty clay with little f-c sand (CL-ML)						9.9	17.6	13.1	4.5	92937	
3C	34½-36'	SS 14	gray silty clay (CL-ML)						10.6	21.1	14.2	6.9	92938	
3C	64½-66'	SS 20	gray silty clay with some f-c sand & f gravel (CL-ML)						7.3	19.8	14.3	5.5	92939	
3C	104½-106'	SS 28	gray clayey silt with trace sand (ML)						8.7	17.0	13.6	3.4	92940	
3C	129½-131'	SS 33	brown silty clay (CL)						13.7	35.1	19.9	17.2	92941	
3C	139½-141'	SS 35	gray f-m sand with little silt (SM)				12.9						92914	*
4C	6-8'	SS 4	gray clayey silt with little f-c sand (ML)						11.4	16.5	12.6	3.9	93000	
4C	8-10'	SS 5	gray f-c sand with clay (SC)				47.8	2.702	10.1				93001	*

* Graphic Presentations of Results of Triaxial, Consolidation, CBR, Proctor, Grain Size, and other tests follow this summary

** SS = Split Spoon Sample (ASTM D 1586)
UD = Undisturbed Sample (ASTM D 1587)

Materials Testing Consultants, Inc.

JOB NUMBER: 162G

SUMMARY OF LABORATORY TEST DATA

Boring Number	Sample Depth	Sample Type**	Sample Description and USCS Classification	Unit Weight pcf Wet	Unit Weight pcf Dry	Unconfined Compressive Strength KSF	Percent Finer No. 200 Sieve	Specific Gravity	Natural Moisture Content	Atterberg Limits L.L.	Atterberg Limits P.L.	Atterberg Limits P.I.	MTCI Sample Number	
4C	12-14'	SS 7	gray f-c sand with clay (SC)				39.4	2.728	4.8				93002	*
4C	18-19'	SS 10	gray silty clay (CL)						7.6	19.1	11.9	7.2	93003	
4C	20-22'	SS 11	gray clay with f-c sand (CL)				53.0	2.734	3.1				93004	*
4C	39½-41'	SS 16	gray clay with f-c sand (CL)						9.9	21.8	12.8	9.0	93005	
4C	54½-56'	SS 19	greenish gray clay (CL).						19.9	38.0	17.6	10.4	93006	
4C	94½-95.9	SS 27	gray clayey silt (ML)						9.4	18.2	14.6	3.6	92942	
4C	139½-141'	SS 36	brown silty clay with f-c sand (CL)						8.2	37.6	16.1	21.5	92943	
4C	149½-150.9'	SS 38	gray fine sand with little silt (SM)				13.1						92915	*
4C	154½-155½'	SS 39	gray f-c sand with little silt (SM)				12.7						92916	*
5A	4½-6½'	SS 1	brown & gray mottled silty clay w/tr gravel (CL-ML)						7.8	19.4	14.2	5.2	92944	

* Graphic Presentations of Results of Triaxial, Consolidation, CBR, Proctor, Grain Size, and other tests follow this summary

** SS = Split Spoon Sample (ASTM D 1586)
UD = Undisturbed Sample (ASTM D 1587)

Materials Testing Consultants, Inc.

JOB NUMBER: 162G

SUMMARY OF LABORATORY TEST DATA

Boring Number	Sample Depth	Sample Type**	Sample Description and USCS Classification	Unit Weight pcf		Unconfined Compressive Strength KSF	Percent Finer No. 200 Sieve	Specific Gravity	Natural Moisture Content	Atterberg Limits			MTCI Sample Number	
				Wet	Dry					L.L.	P.L.	P.I.		
5A	9½-11½'	SS 2	gray f-c sand with silt (SM)				43.6	2.716					92917	*
5A	19½-20½'	SS 4	gray f-c sand with little f gravel (SW)				2.8						92918	*
5A	29½-31½'	SS 6	gray f-c sand with trace gravel and silt (SW)				5.9						92919	*
5A	29½-31½	SS 7	gray fine sand with some silt (SM)				26.7						92920	*

* Graphic Presentations of Results of Triaxial, Consolidation, CBR, Proctor, Grain Size, and other tests follow this summary

** SS = Split Spoon Sample (ASTM D 1586)
UD = Undisturbed Sample (ASTM D 1587)

Materials Testing Consultants Inc
[illegible]

JOB NUMBER: 162G

GRADATION CURVE

CLIENT CH2M HILL

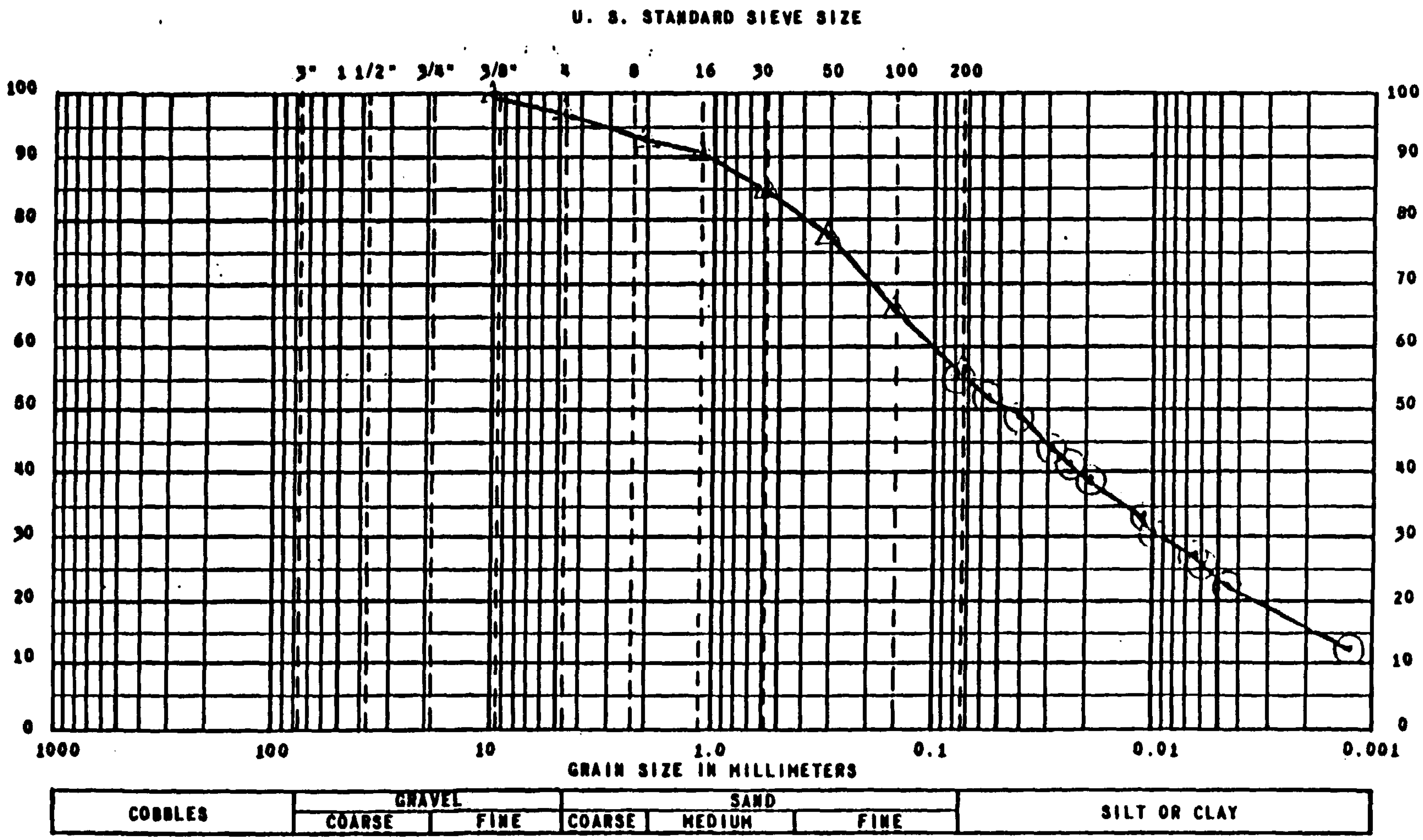
PROJECT Zionsville, Indiana

JOB NUMBER 162G

BORING NUMBER B 1A

SAMPLE NUMBER 92900

DATE 7/25/83



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 1A	34.5-36'	CL	gray clay w/f-c sand and f gravel					

TECHNICIAN LH

COMPUTED BY LH

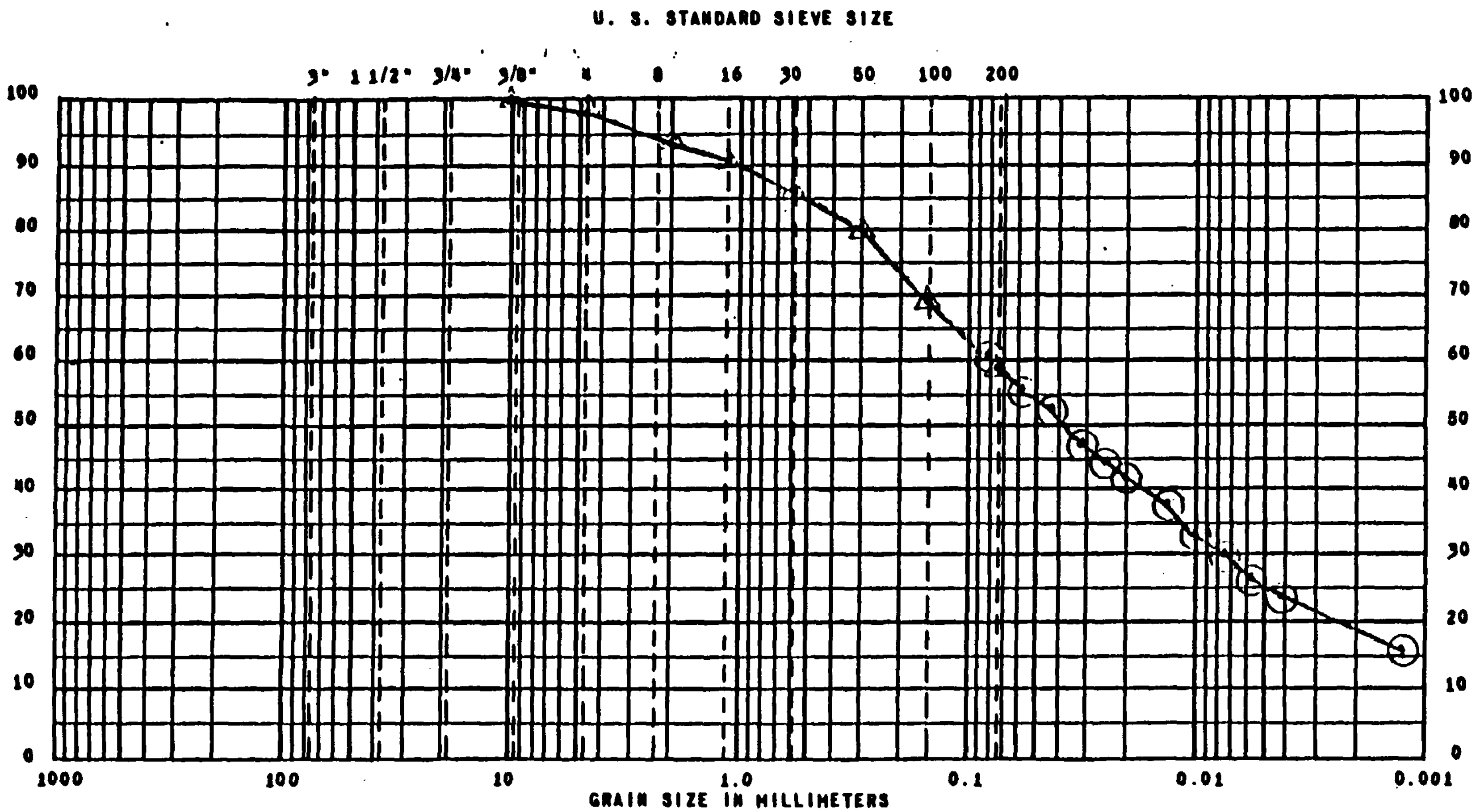
CHECKED BY JNS

REMARKS

Materials Testing Consultants

GRADATION CURVE

CLIENT CH2M HILL
JOB NUMBER 162G
PROJECT Zionsville, Indiana
BORING NUMBER B 1A
SAMPLE NUMBER 92899
DATE 7/25/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 1A	4-6'	CL	gray clay w/f-c sand and f. gravel					

TECHNICIAN LH
COMPUTED BY LH
CHECKED BY JNS
REMARKS

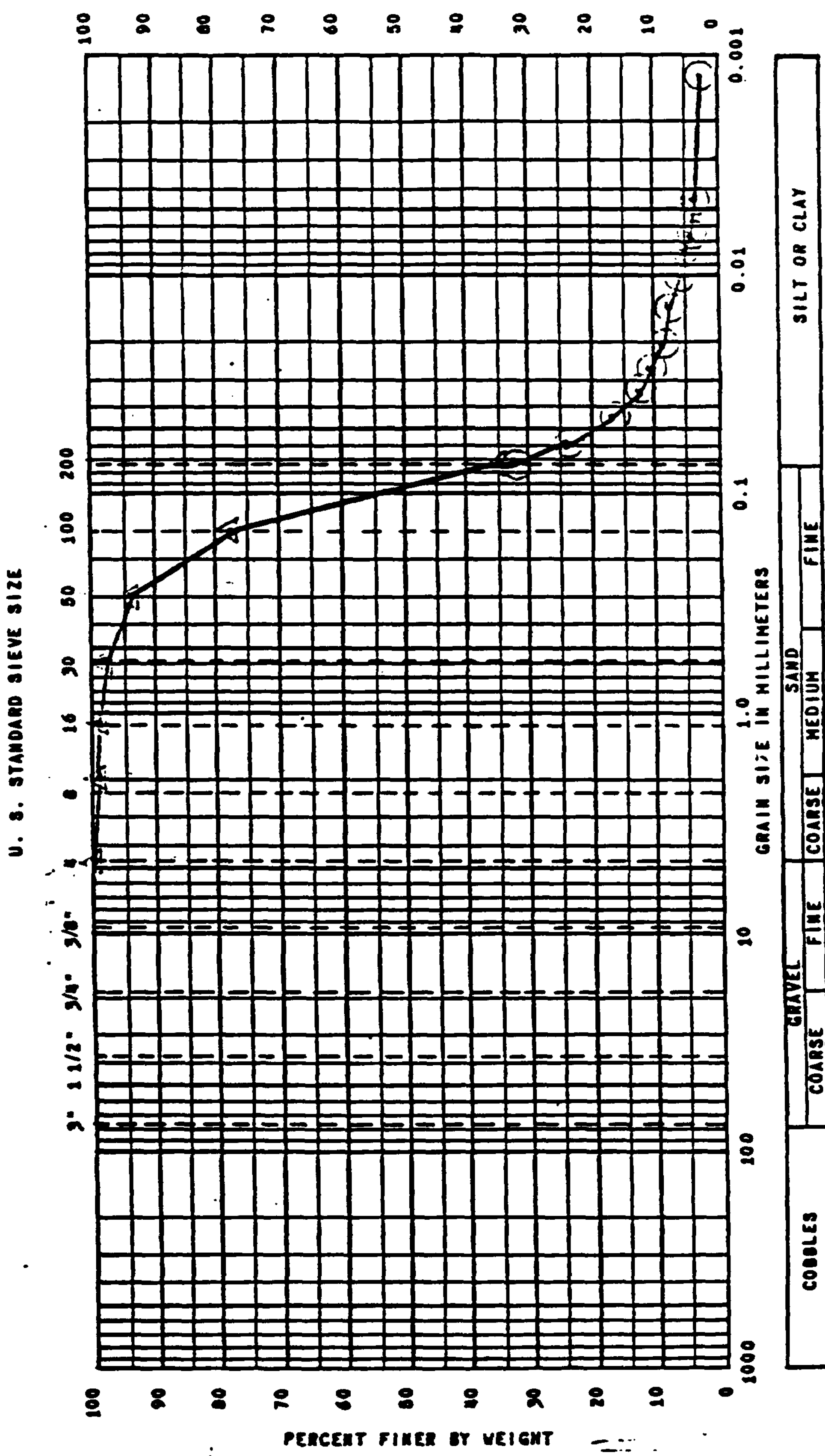
Materials Testing Consultants

GRADATION CURVE

DATE 7/25/83

CLIENT ~~CH2M HILL~~ PROJECT Zionsville, Indiana

JOB NUMBER 162G BORING NUMBER B 1C SAMPLE NUMBER 92902



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI
B 1C	29½-31'	SM	gray fine sand w/some silt				

TECHNICIAN LH COMPUTED BY LH CHECKED BY JNS

REMARKS

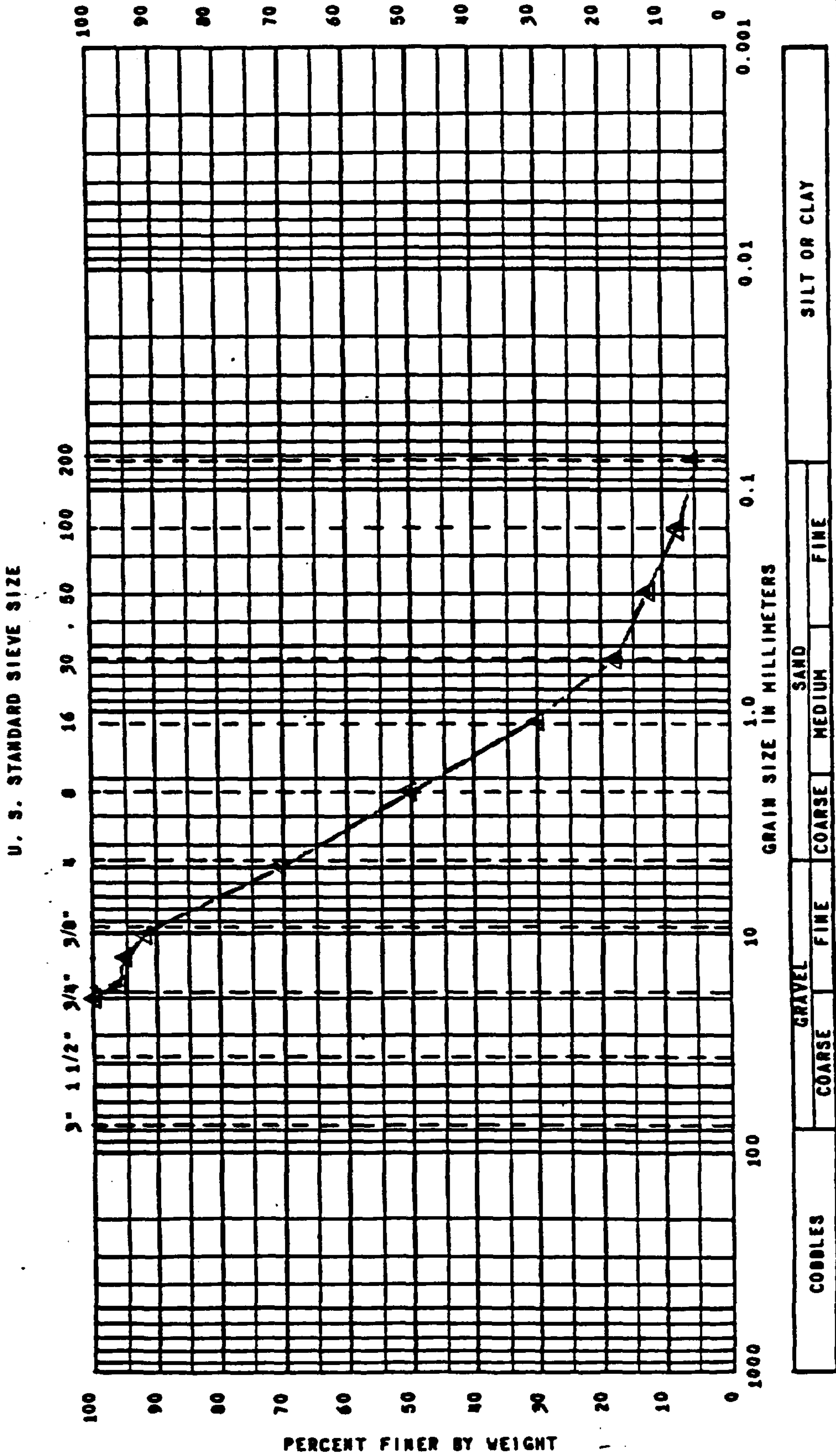
Materials Testing Consultants

GRADATION CURVE

DATE 7/11/83

CLIENT CH2M HILL PROJECT Zionsville, Indiana

JOB NUMBER 162G BORING NUMBER B 1C SAMPLE NUMBER 92901



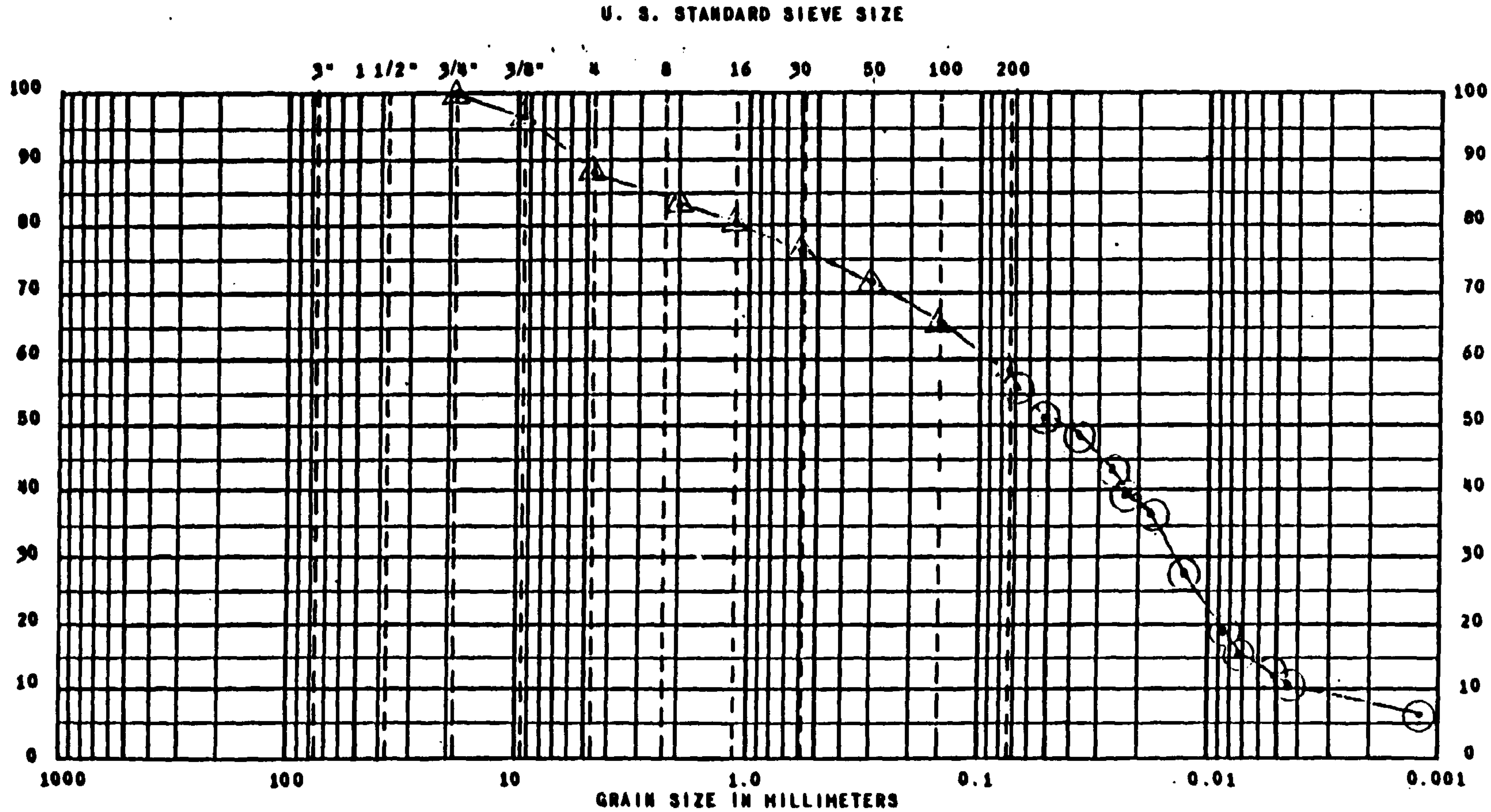
BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI
B 1C	23-1/2 to 25'	SW	gray f-c sand w/some f gravel				

TECHNICIAN LH & GT COMPUTED BY LH CHECKED BY JNS

REMARKS

GRADATION CURVE

CLIENT CH2M HILL
PROJECT Zionsville, Indiana
DATE 7/25/83
JOB NUMBER 162G
BORING NUMBER B 1C
SAMPLE NUMBER 92904



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 1C	74½-76'	ML	brown silt w/f-c sand & f gravel					

TECHNICIAN LH
COMPUTED BY LH
CHECKED BY JNS

Materials Testing Consult.

GRADATION CURVE

CLIENT CH2M HILL

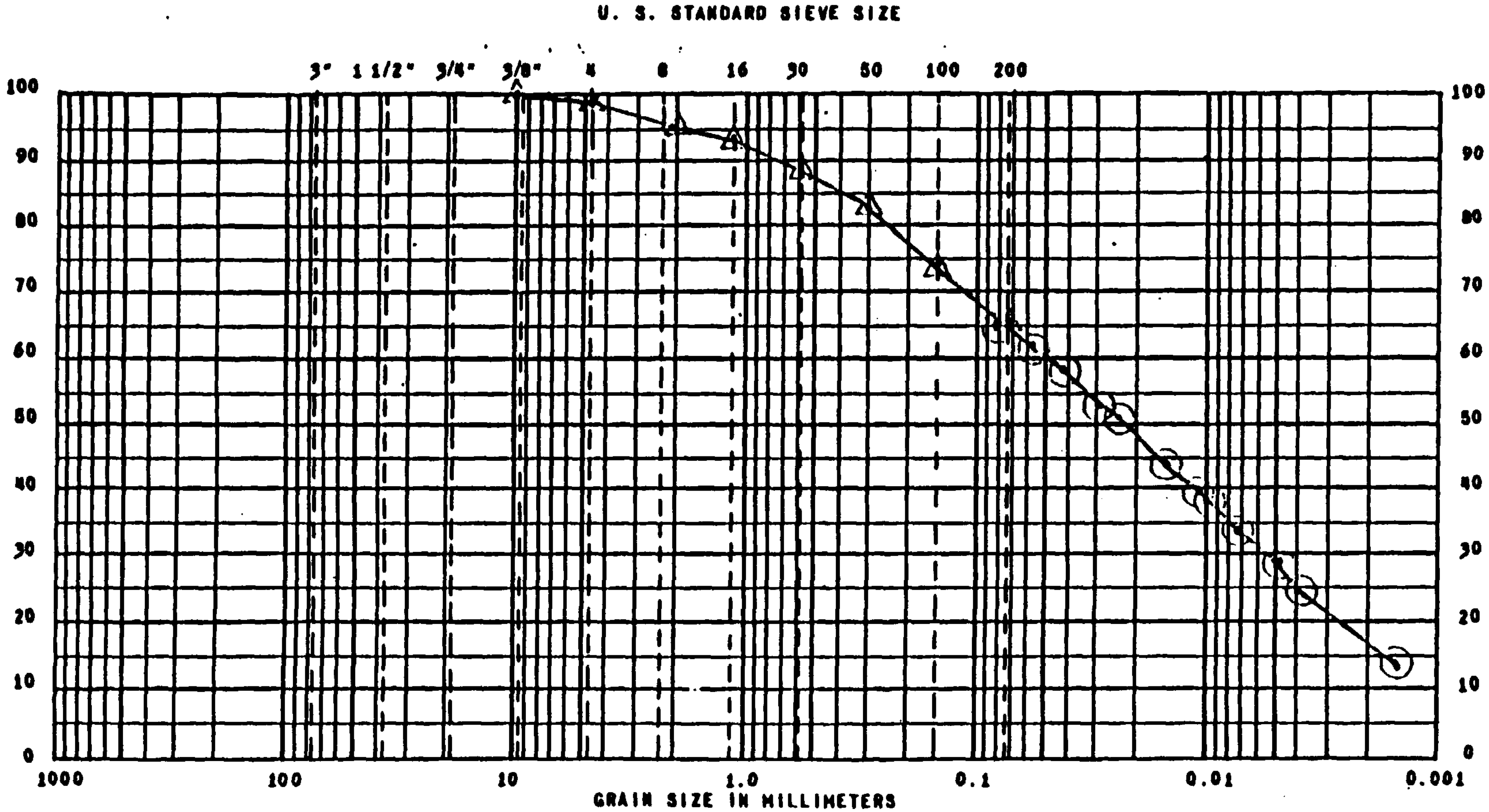
JOB NUMBER 162G

PROJECT Zionsville, Michigan

BORING NUMBER B 1C

SAMPLE NUMBER 92903

DATE 7/25/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 1C	39½-41'	CL	gray clay w/f-c sand & f gravel					

TECHNICIAN LH

COMPUTED BY LH

CHECKED BY JNS

REMARKS

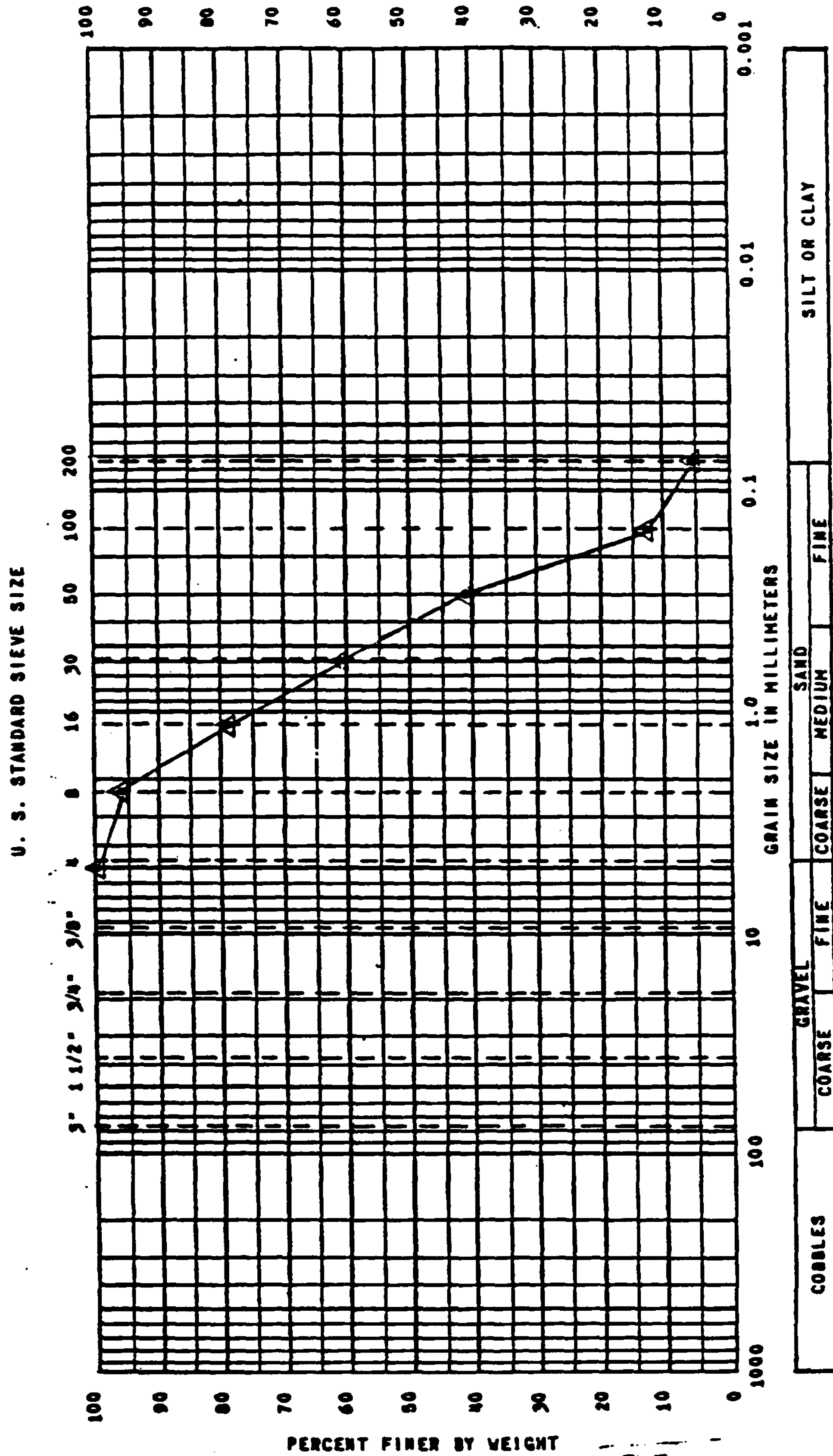
Materials Testing Consultants

GRADATION CURVE

DATE 7/8/83

CLIENT CH2M HILL PROJECT Zionsville, Indiana

JOB NUMBER 162G BORING NUMBER B 2C SAMPLE NUMBER 92906



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI
B 2C	16–18'	SP	gray f–c sand				

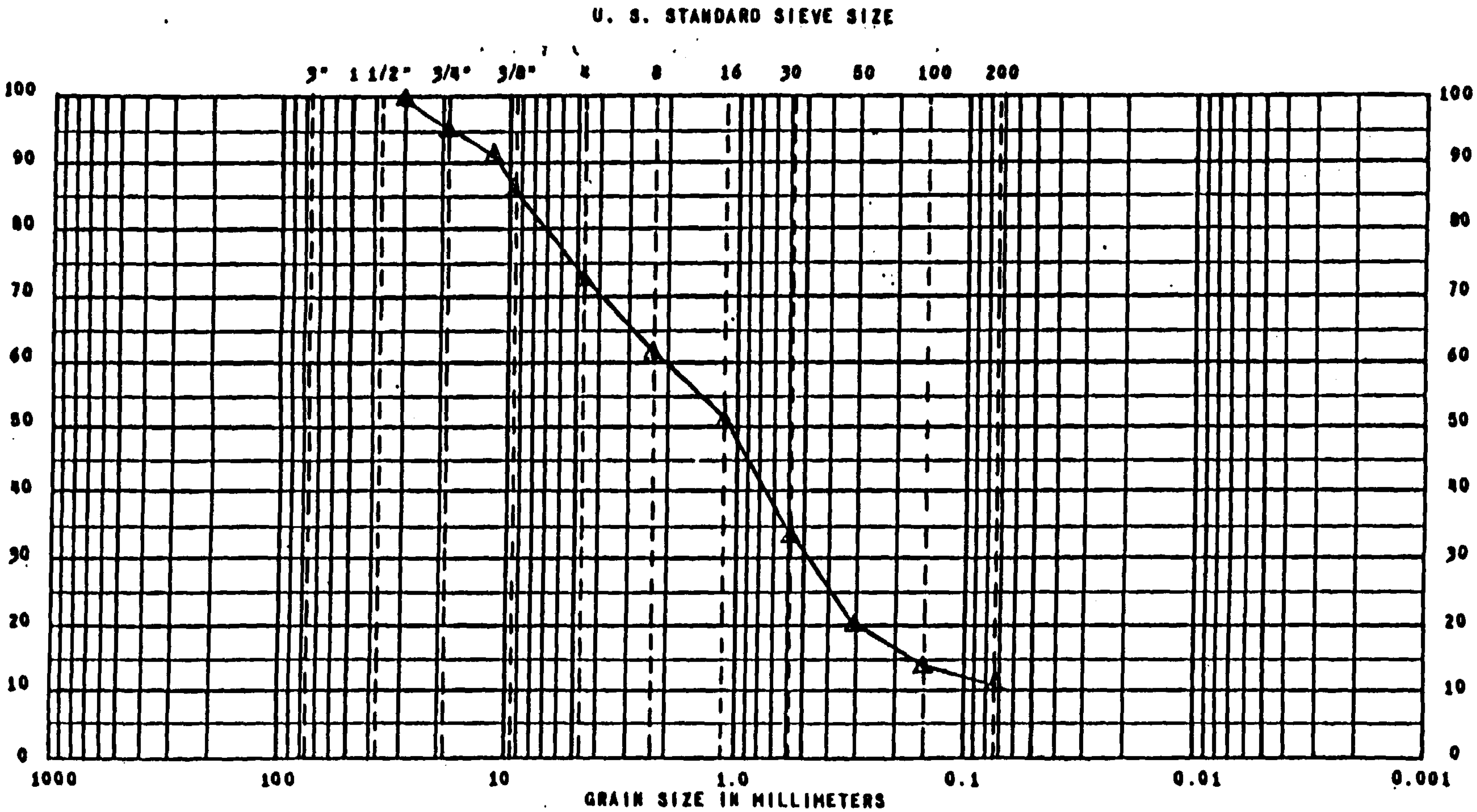
TECHNICIAN LH COMPUTED BY LH CHECKED BY JNS

REMARKS

Materials Testing Consult.

GRADATION CURVE

CLIENT: CH2M HILL
JOB NUMBER: 162G
PROJECT: Zionsville, Indiana
BORING NUMBER: B 1C
SAMPLE NUMBER: 92905
DATE: 7/8/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION	NAT. WC	LL	PL	PI	
B 1C	154½-156'	SM-SW gray silty f-c sand w/ some f gravel					

TECHNICIAN: LH
COMPUTED BY: LH
CHECKED BY: JNS

GRADATION CURVE

CLIENT CH2M HILL

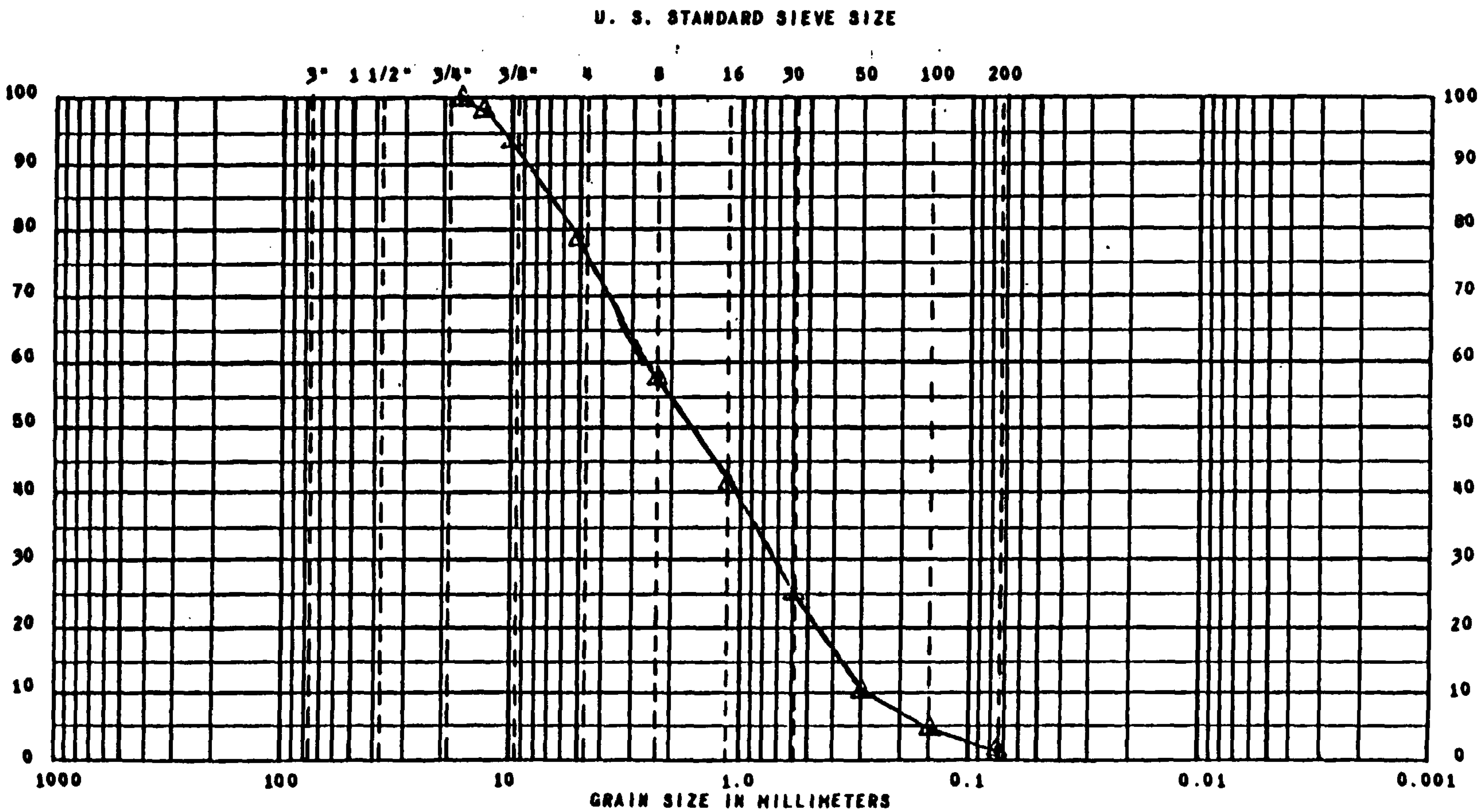
PROJECT Zionsville, Indiana

JOB NUMBER 162G

BORING NUMBER B 2C

SAMPLE NUMBER 92965

DATE 7/11/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 2C	26–28'	SW	gray f-c sand with some f gravel					

TECHNICIAN LH & GT

COMPUTED BY LH

CHECKED BY JNS

REMARKS

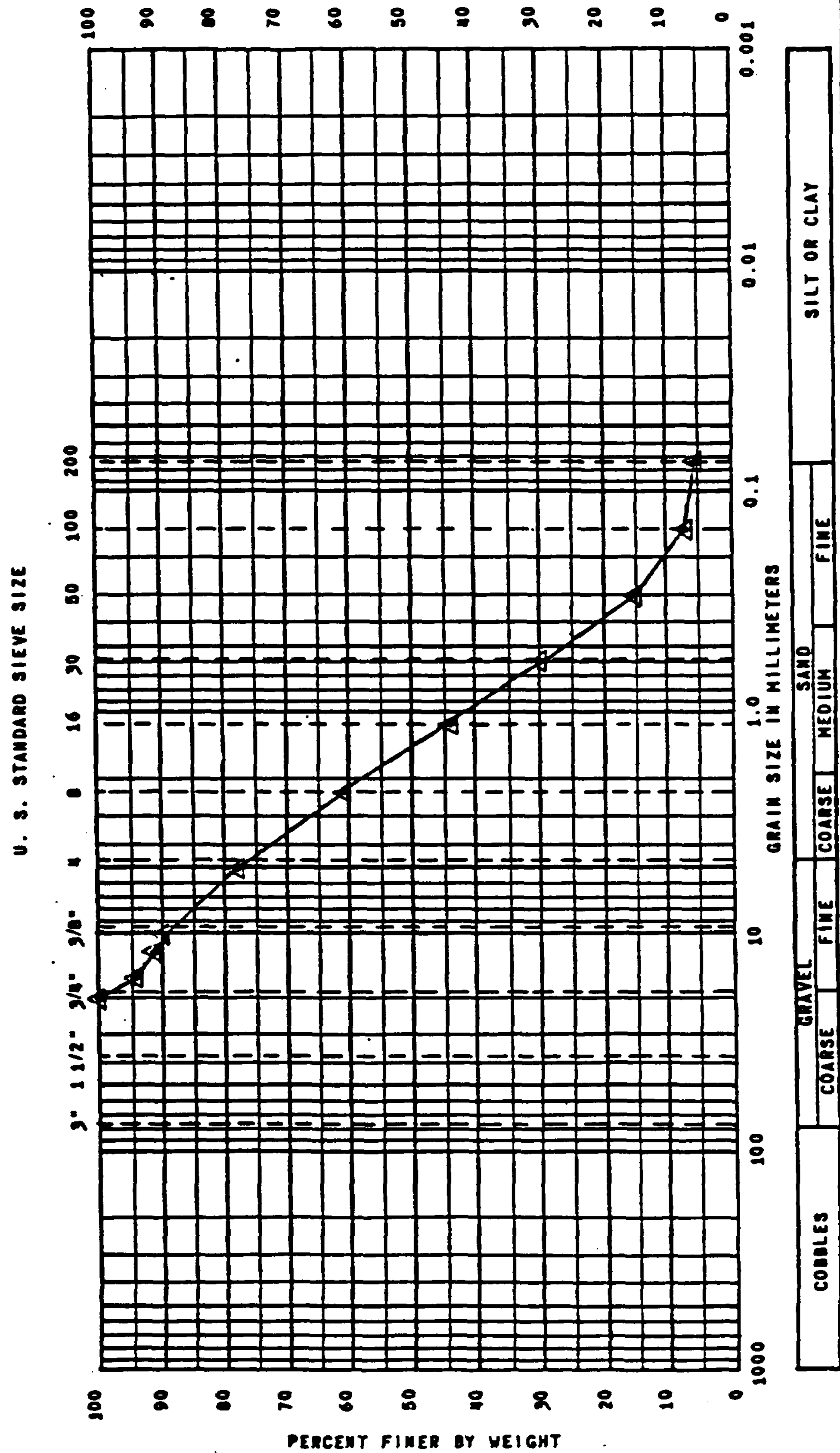
Materials Testing Consultants

GRADATION CURVE

DATE 7/11/83

CLIENT CH2M HILL PROJECT Zionsville, Indiana

JOB NUMBER 162G BORING NUMBER B 2C SAMPLE NUMBER 92907



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI
B 2C	20-22'	Sw	gray f-c sand w/some fine gravel				

TECHNICIAN LH & GT COMPUTED BY LH CHECKED BY JNS

REMARKS

Materials Testing · Consultants

GRADATION CURVE

CLIENT: CH2M HILL

JOB NUMBER: 162G

PROJECT: Zionsville, Indiana

BORING NUMBER: B 2C

SAMPLE NUMBER: 92909

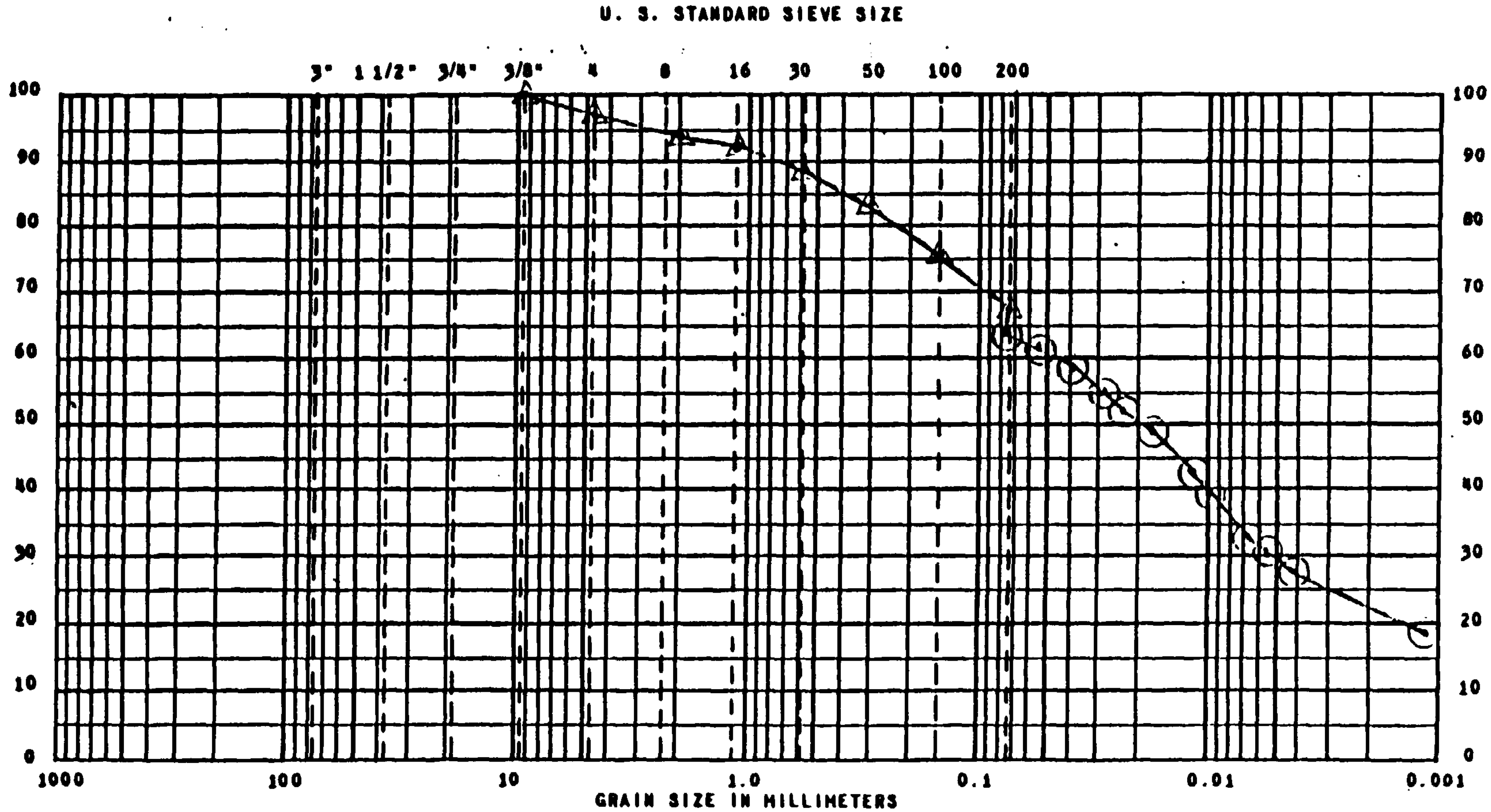
DATE: 7/25/83

TECHNICIAN: LH

COMPUTED BY: LH

CHECKED BY: JNS

REMARKS

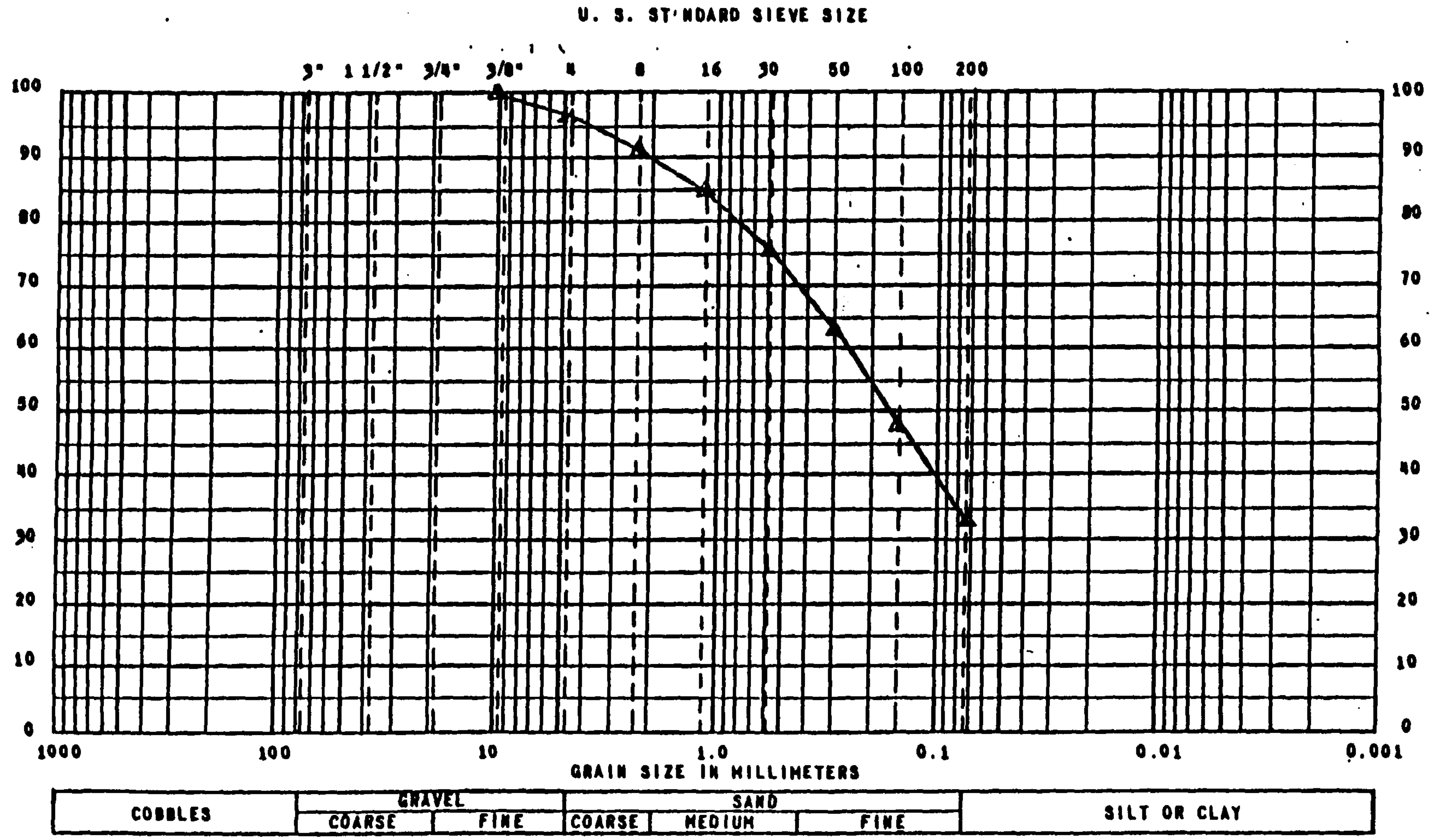


COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 2C	49½'-51'	CL	gray clay with some f-c sand					

GRADATION CURVE

CLIENT CH2M HILL
PROJECT Zionsville, Indiana
JOB NUMBER 162G
BORING NUMBER B 2C
SAMPLE NUMBER 92908
DATE 7/5/83



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 2C	32-34'	SM	gray f-c sand with some silt					

TECHNICIAN LH
COMPUTED BY LH
CHECKED BY JNS
REMARKS

GRADATION CURVE

CLIENT CH2M HILL

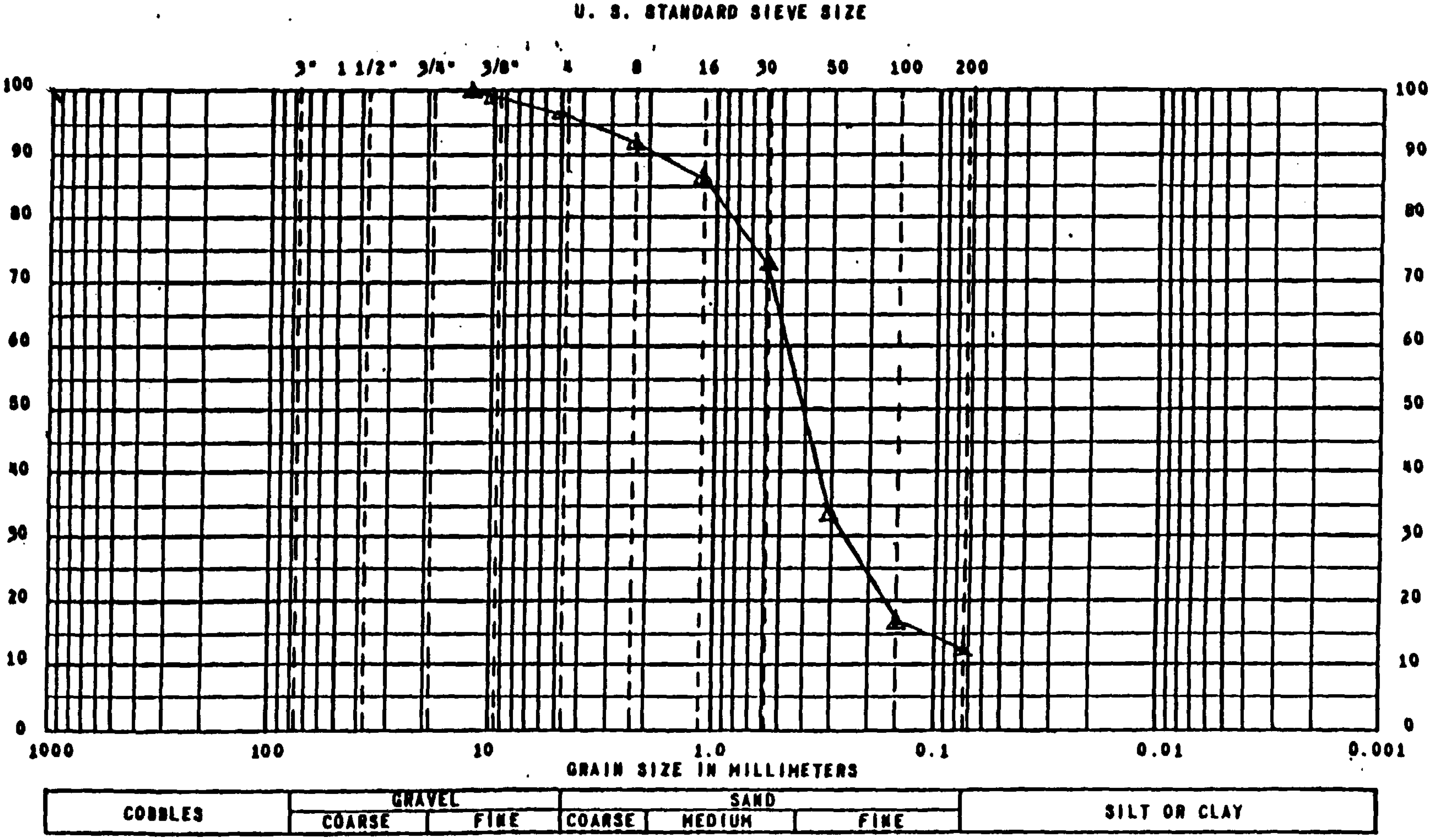
PROJECT Zionsville, Indiana

DATE 7/5/83

JOB NUMBER 162G

BORING NUMBER B 2C

SAMPLE NUMBER 92911



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 2C	149½-151'	SM	gray f-m sand w/limestone chips & little silt					

TECHNICIAN LH

COMPUTED BY LH

CHECKED BY JNS

GRADATION CURVE

CLIENT CH2M HILL

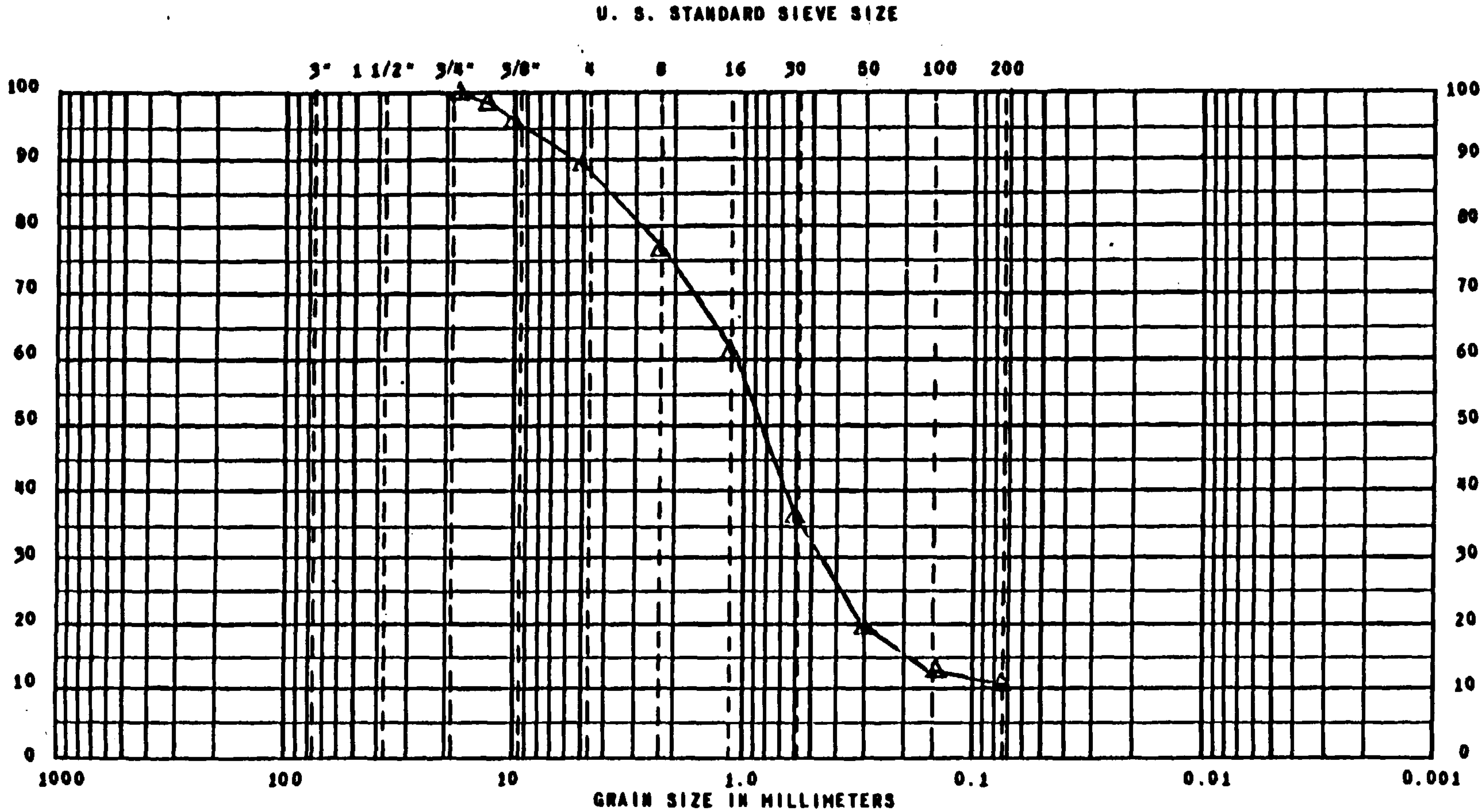
PROJECT Zionsville, Indiana

JOB NUMBER 162G

BORING NUMBER B 2C

SAMPLE NUMBER 92910

DATE 7/11/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 2C	99½ to 100½'	SP-SM	brown f-c sand with little gravel					

TECHNICIAN LH & GT

COMPUTED BY LH

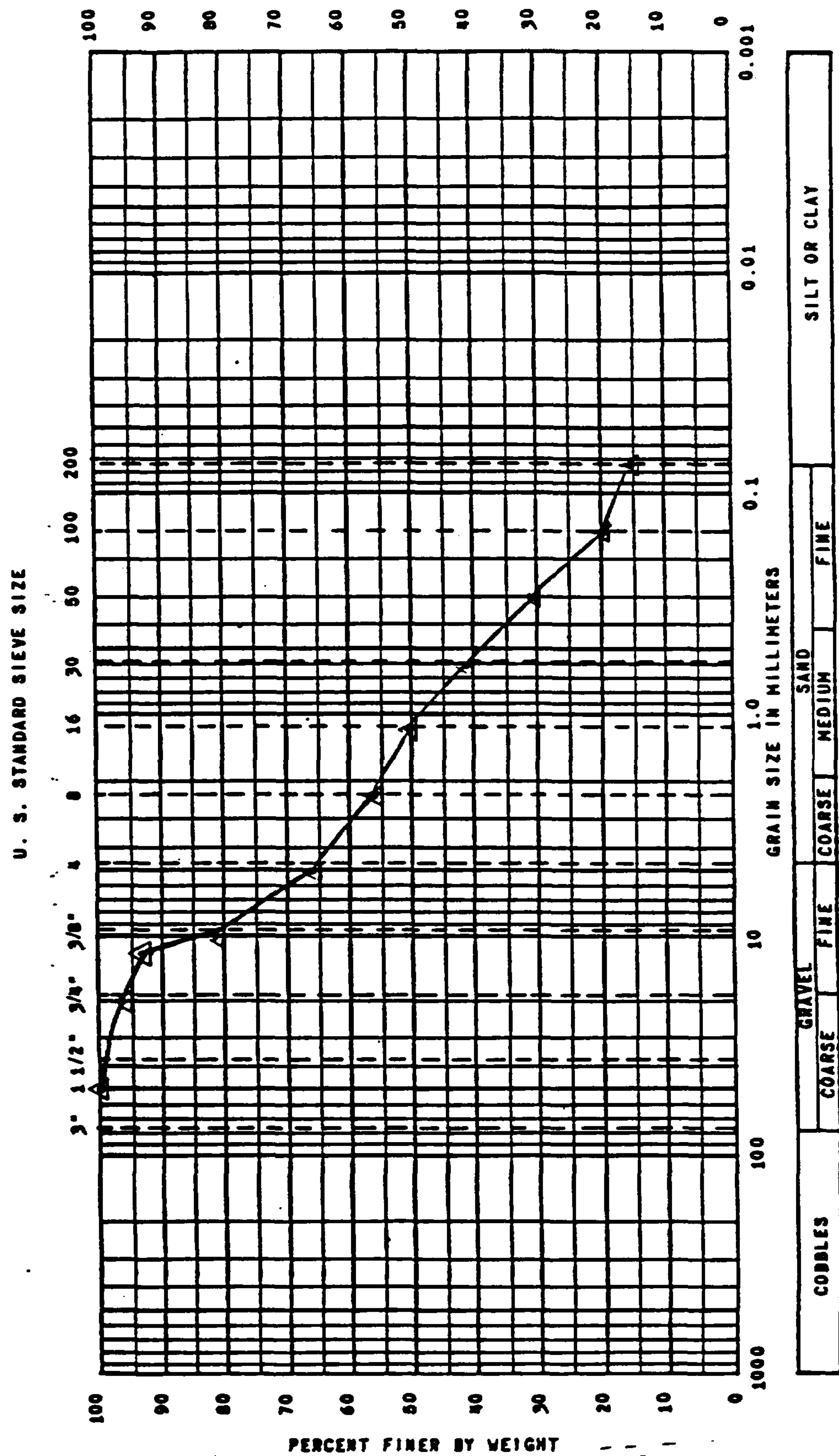
CHECKED BY JNS

GRADATION CURVE

DATE 7/8/83

CLIENT CH2M HILL PROJECT Zionsville, Indiana

JOB NUMBER 162G BORING NUMBER B 3A SAMPLE NUMBER 92913



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI
B 3A	14-16'	SM	brown f-c sand w/little f-c gravel & silt				

TECHNICIAN LH COMPUTED BY LH CHECKED BY JNS

REMARKS

Materials Testing Consultants

GRADATION CURVE

CLIENT CH2M HILL

PROJECT Zionsville, Indiana

JOB NUMBER 162G

BORING NUMBER B 3A

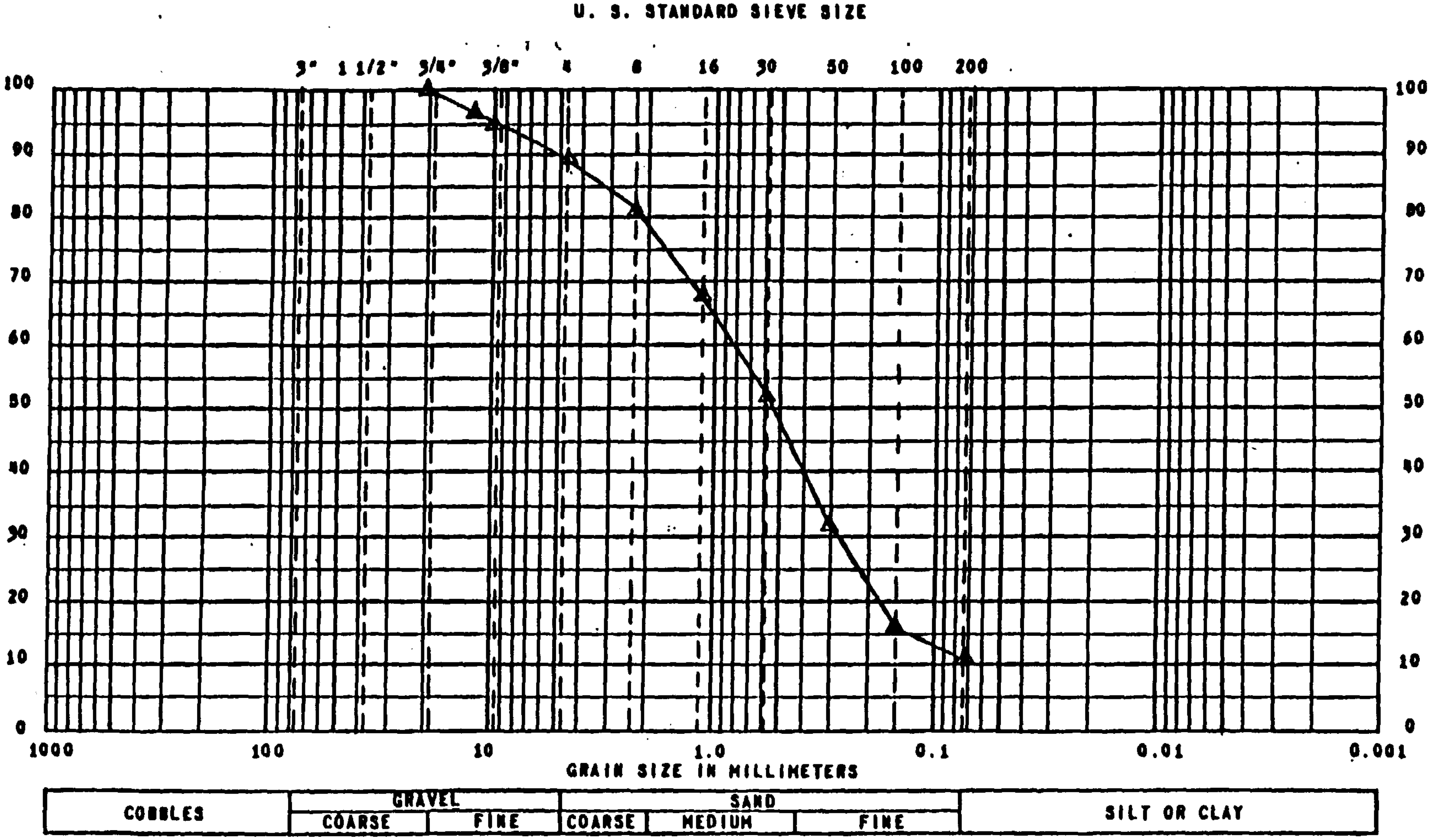
SAMPLE NUMBER 92912

DATE 7/7/83

TECHNICIAN LH

COMPUTED BY LH

CHECKED BY JNS



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 3A	8-10'	SM-SW	brown f-c sand with little silt					

GRADATION CURVE

CLIENT CH2M HILL

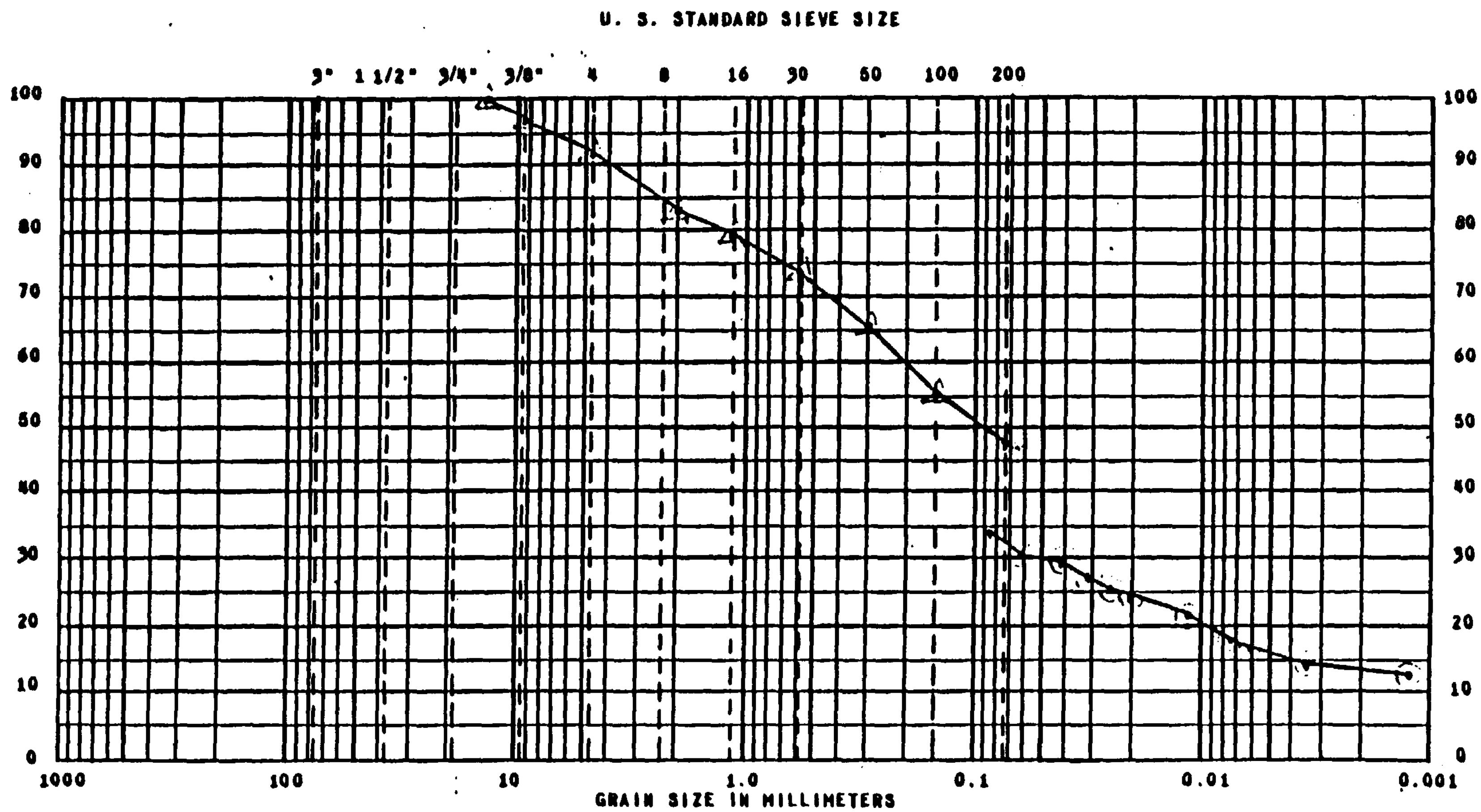
JOB NUMBER 162G

PROJECT Zionsville, Indiana

BORING NUMBER B 4C

SAMPLE NUMBER 93001

DATE 7/13/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 4C	8 - 10'	SC	gray f-c sand w/ clay					

TECHNICIAN IH

COMPUTED BY IH

CHECKED BY JNS

REMARKS

GRADATION CURVE

CLIENT CH2M HILL

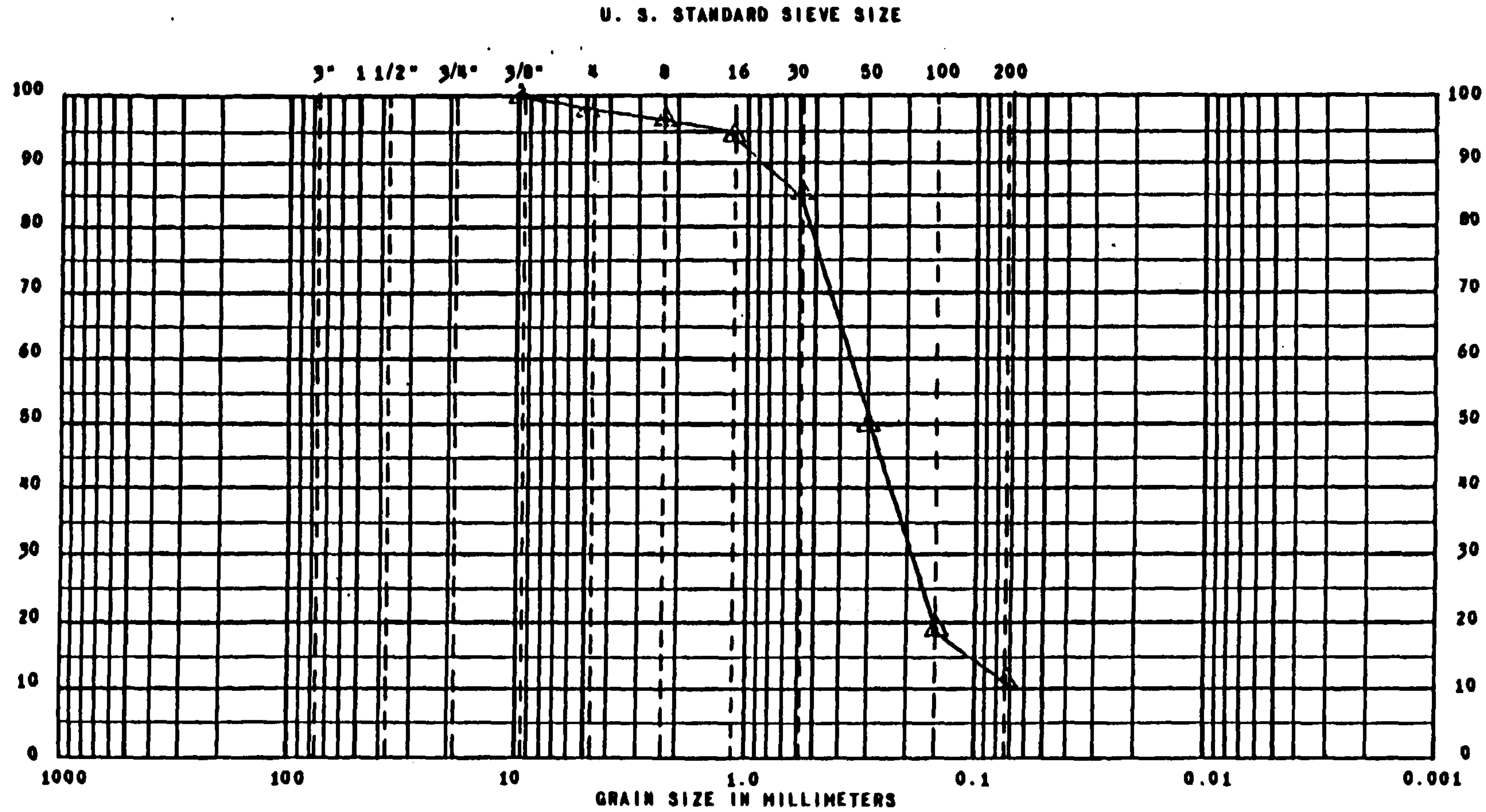
JOB NUMBER 162G

PROJECT Zionsville, Indiana

BORING NUMBER B 3C

SAMPLE NUMBER 92914

DATE 7/7/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 3C	139.5 to 141'	SM	gray f-m sand with little silt					

TECHNICIAN LH & GT

COMPUTED BY LH

CHECKED BY JNS

REMARKS

Materials Testing Consultants

GRADATION CURVE

CLIENT CH2M HILL

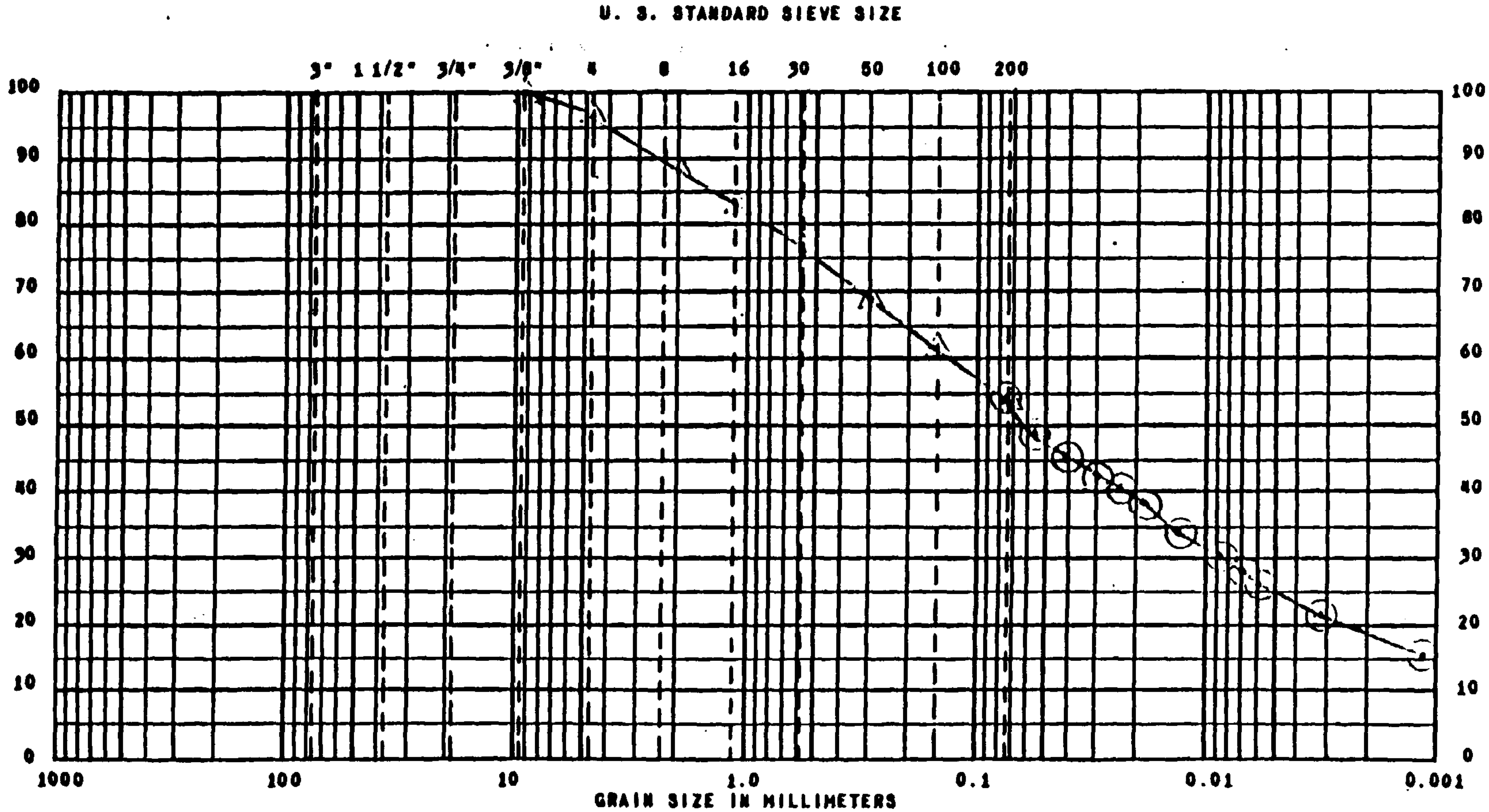
JOB NUMBER 162G

PROJECT Zionsville, Indiana

BORING NUMBER B 4C

SAMPLE NUMBER 93004

DATE 7/25/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 4C	20-22'	CL	gray clay w/f-c sand					

TECHNICIAN LH

COMPUTED BY LH

CHECKED BY JNS

REMARKS

GRADATION CURVE

CLIENT CH2M HILL

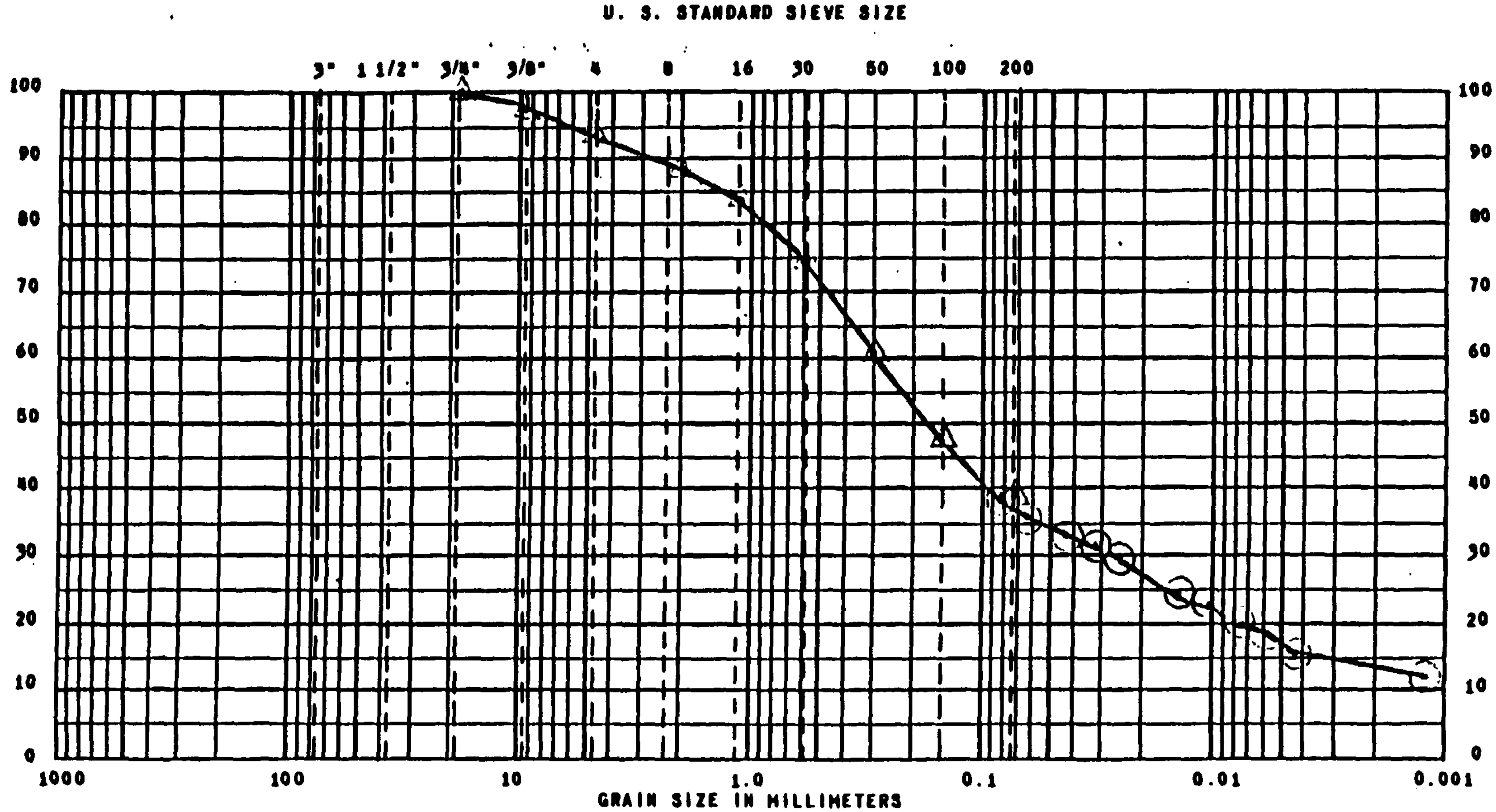
JOB NUMBER 162G

PROJECT Zionsville, Indiana

BORING NUMBER B 4C

SAMPLE NUMBER 93002

DATE 7/25/8?



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 4C	12-14'	SC	gray f-c sand with clay					

TECHNICIAN LH

COMPUTED BY LH

CHECKED BY JNS

REMARKS

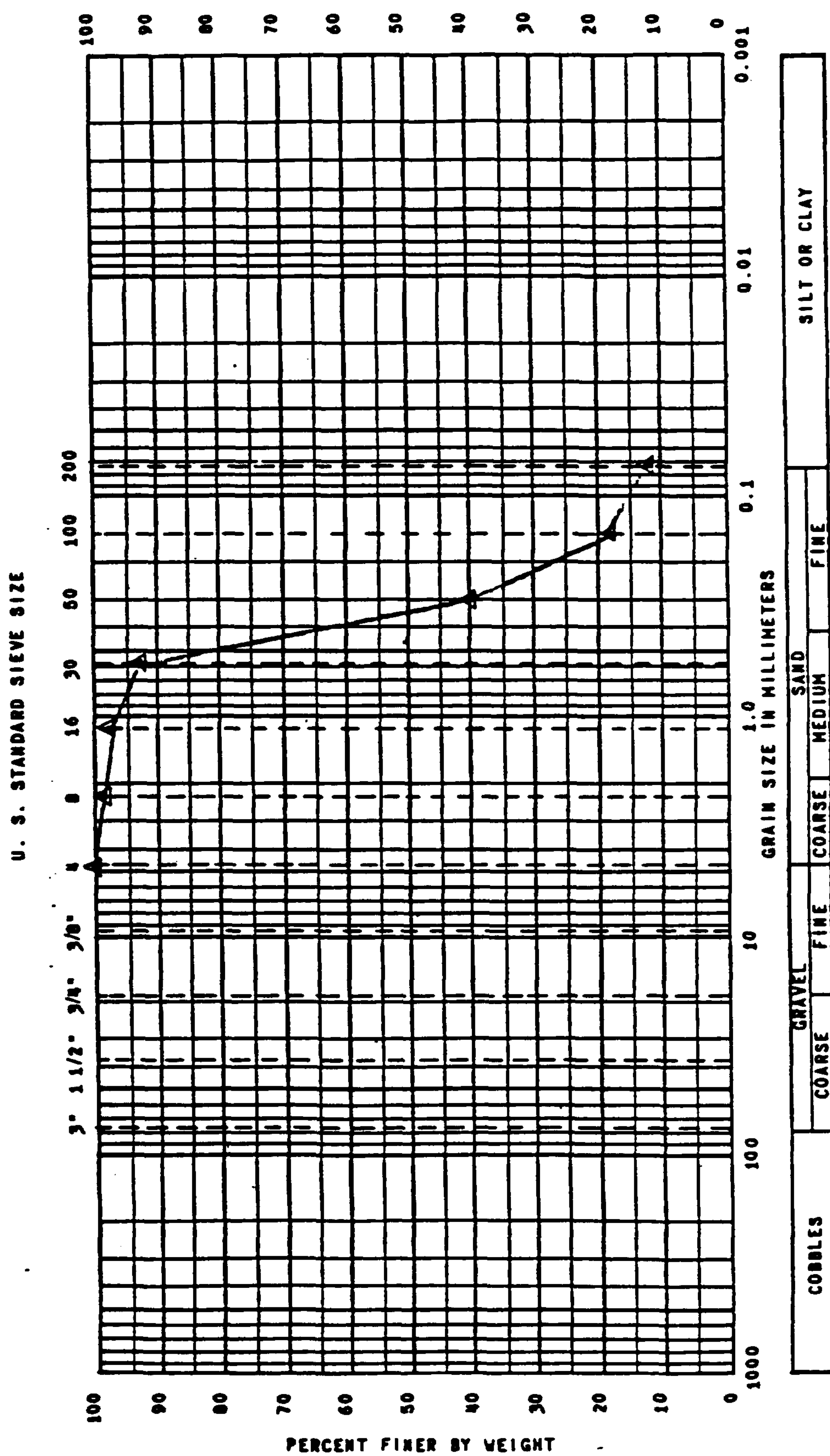
Materials Testing Consultants

GRADATION CURVE

DATE 7/11/83

CLIENT CH2M-HILL PROJECT Zionsville, Indiana

JOB NUMBER 162G BORING NUMBER B 4C SAMPLE NUMBER 92915



BORING	DEPTH	CLASSIFICATION	NAT. WC	LL	PL	PI
B 4C	149.5 - 150.9'	SM gray f sand w/ little silt				

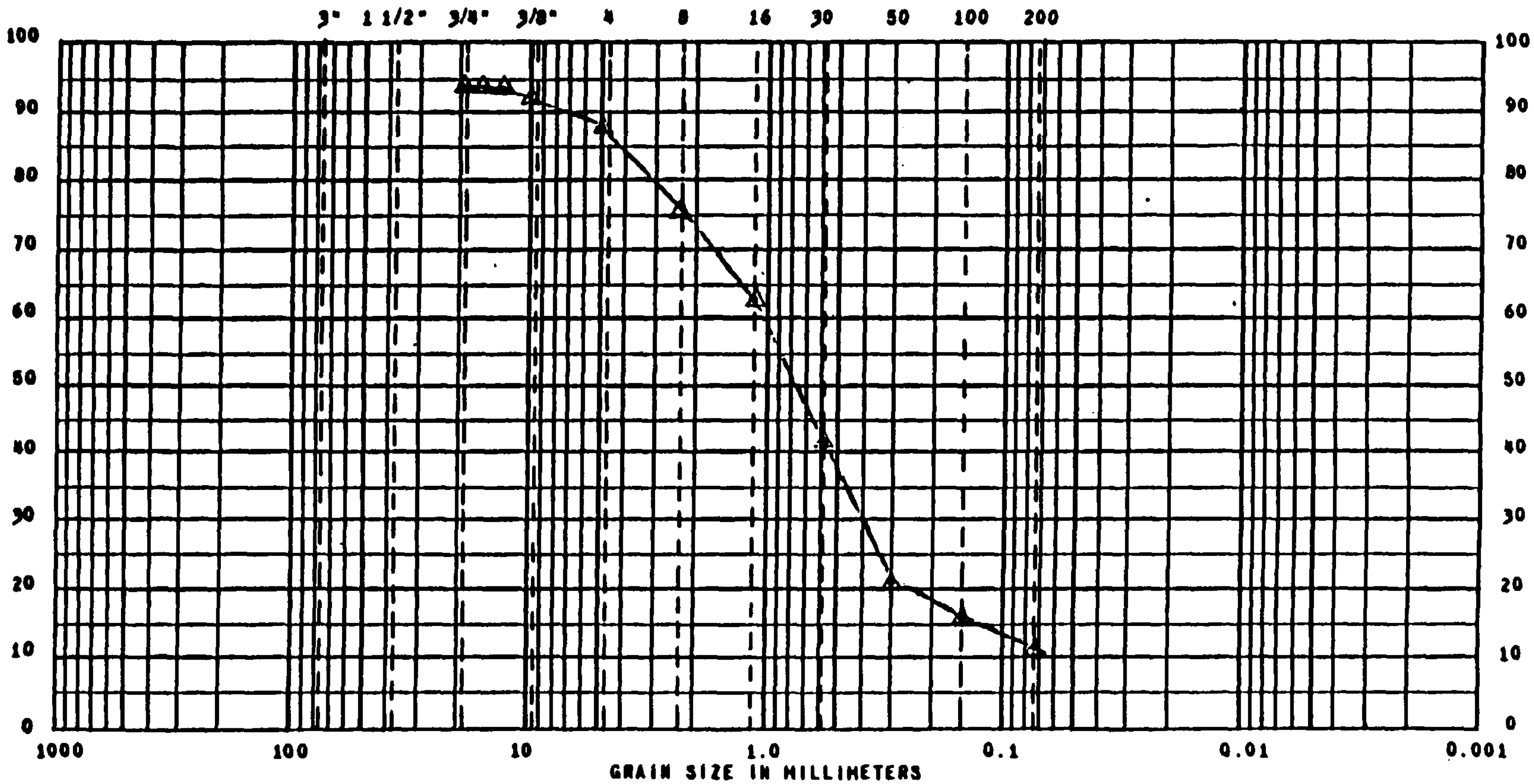
TECHNICIAN LH & GT COMPUTED BY LH CHECKED BY JNS

REMARKS

Materials Testing Consultants

GRADATION CURVE

CLIENT: CH2M HILL
JOB NUMBER: 162G
PROJECT: Zionsville, Michigan
BORING NUMBER: B 4C
SAMPLE NUMBER: 92916
DATE: 7/11/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 4C	154.5 to 155.5	SM	gray f-c sand w/little silt					

TECHNICIAN: LH & GT
COMPUTED BY: LH
CHECKED BY: JNS
REMARKS:

Materials Testing Consultants

GRADATION CURVE

CLIENT CH2M HILL

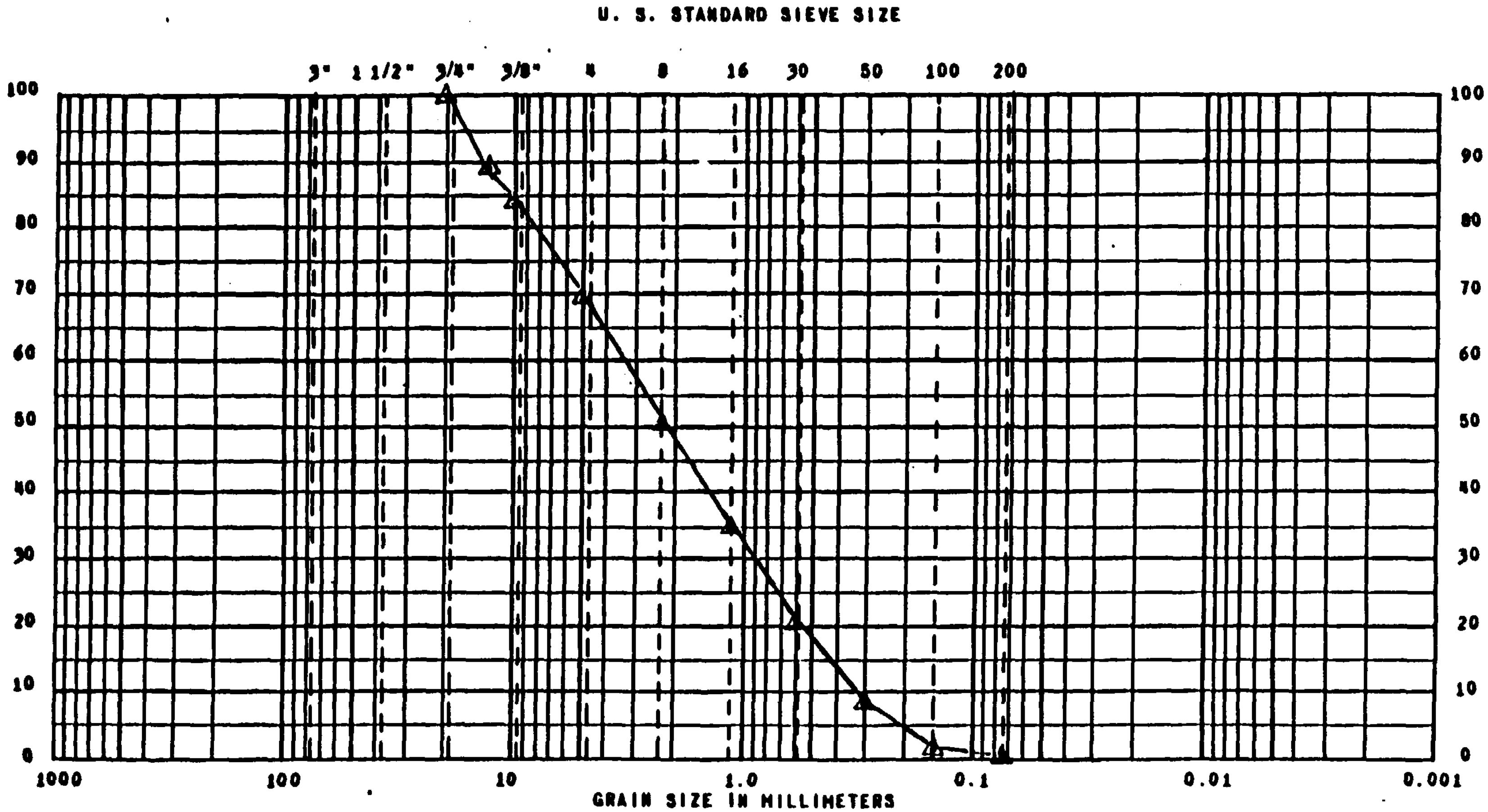
PROJECT Zionsville, Indiana

JOB NUMBER 162G

BORING NUMBER B 5A

SAMPLE NUMBER 92918

DATE 7/8/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 5A	19.5-21.5'	SW	gray f-c sand w/ little fine gravel					

TECHNICIAN LH

COMPUTED BY LH

CHECKED BY JNS

REMARKS

Materials Testing Consultants

GRADATION CURVE

CLIENT: CH2M HILL

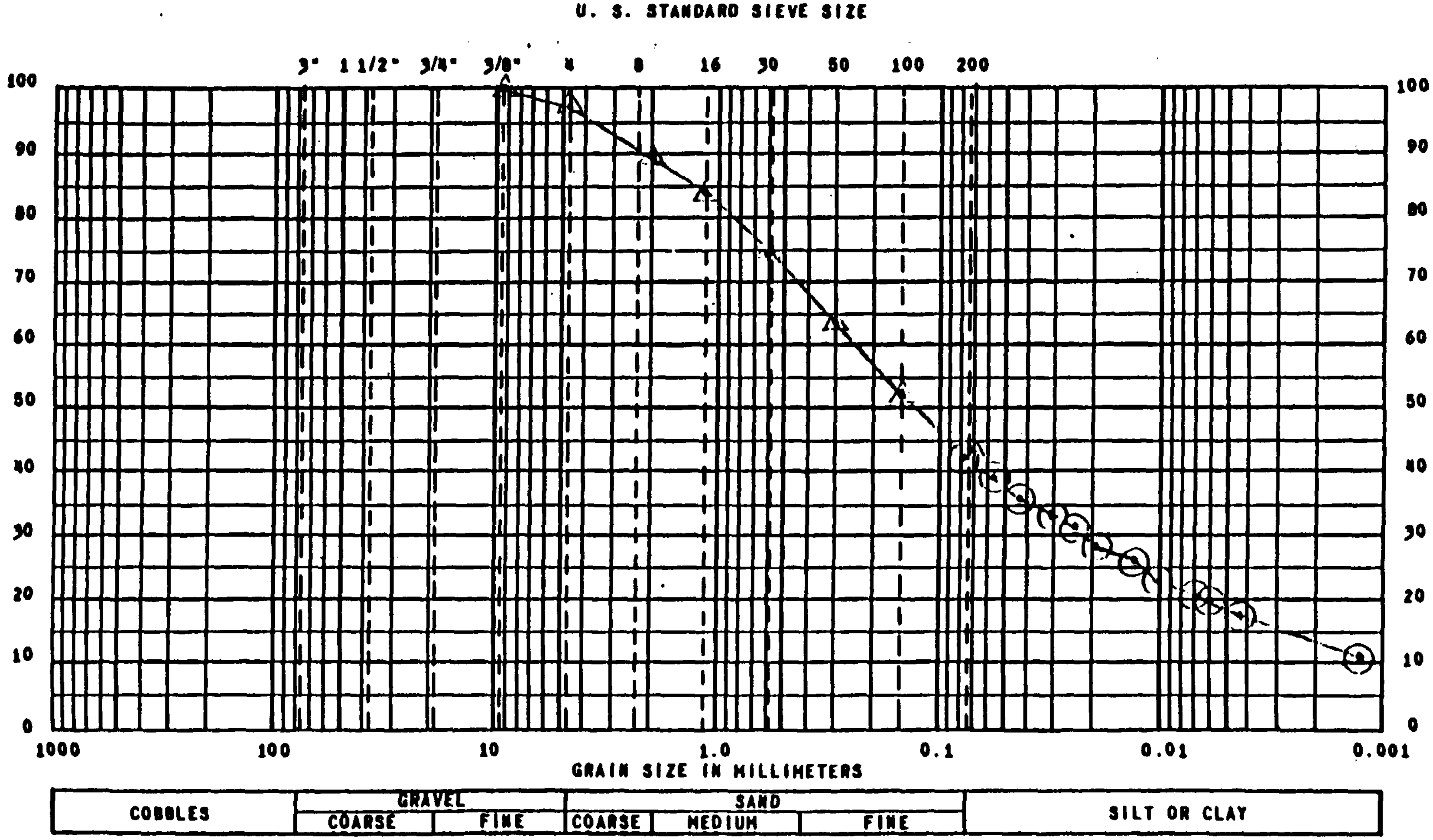
JOB NUMBER: 162G

PROJECT: Zionsville, Indiana

BORING NUMBER: B 5A

SAMPLE NUMBER: 92917

DATE: 7/25/83



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 5A	9.5-11.5'	SM	gray f-c sand w/silt					

TECHNICIAN: LH

COMPUTED BY: LH

CHECKED BY: JNS

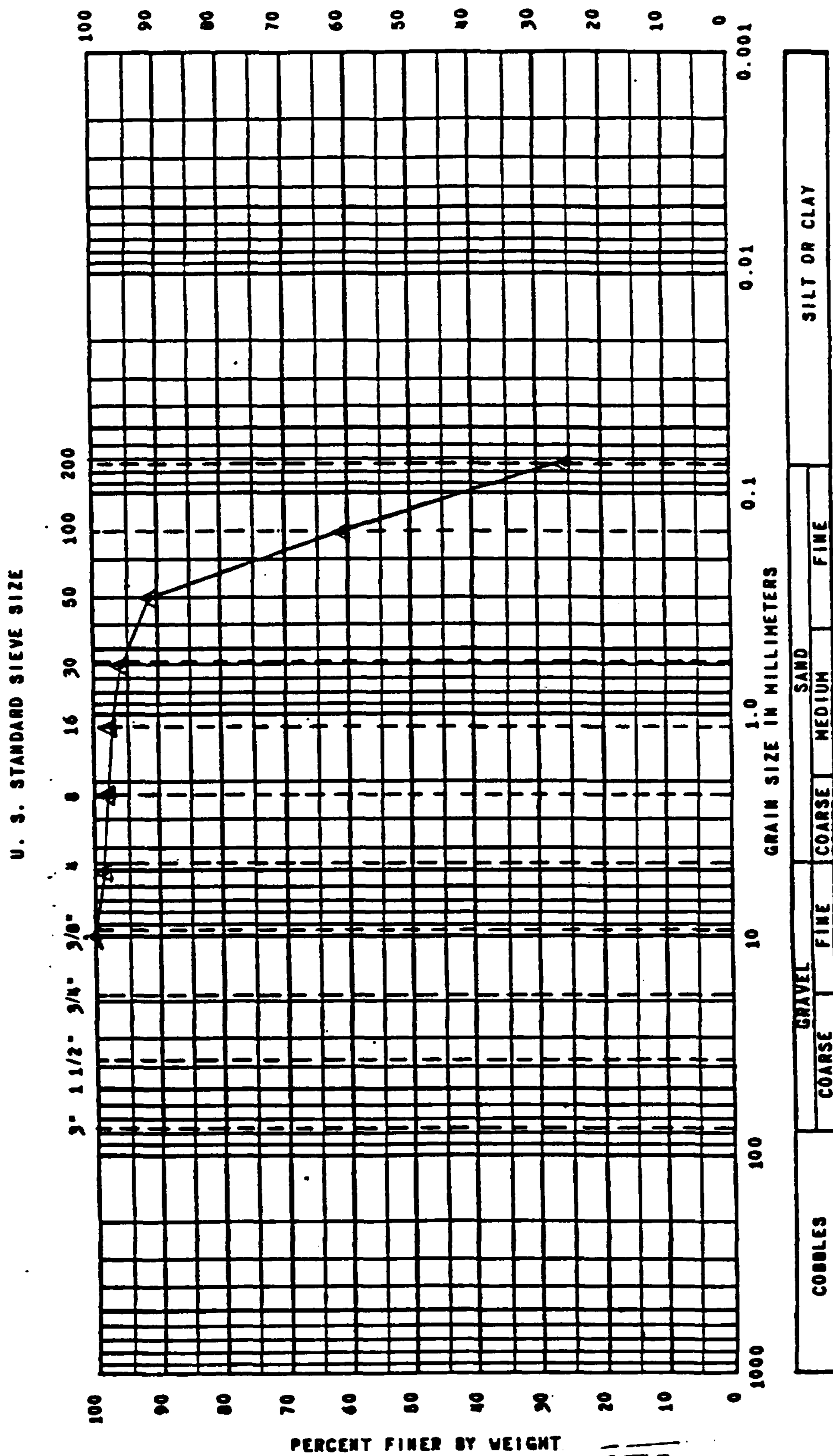
REMARKS:

GRADATION CURVE

DATE 7/25/83

CLIENT CH2M HILL PROJECT Zionsville, Indiana

JOB NUMBER 162G BORING NUMBER B 5A SAMPLE NUMBER 92920



BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI
B 5A	29½-31½'	SM	gray fine sand with some silt				

TECHNICIAN LH COMPUTED BY LH CHECKED BY JNS

REMARKS

Materials Testing Consultants

GRADATION CURVE

CLIENT CH2M HILL

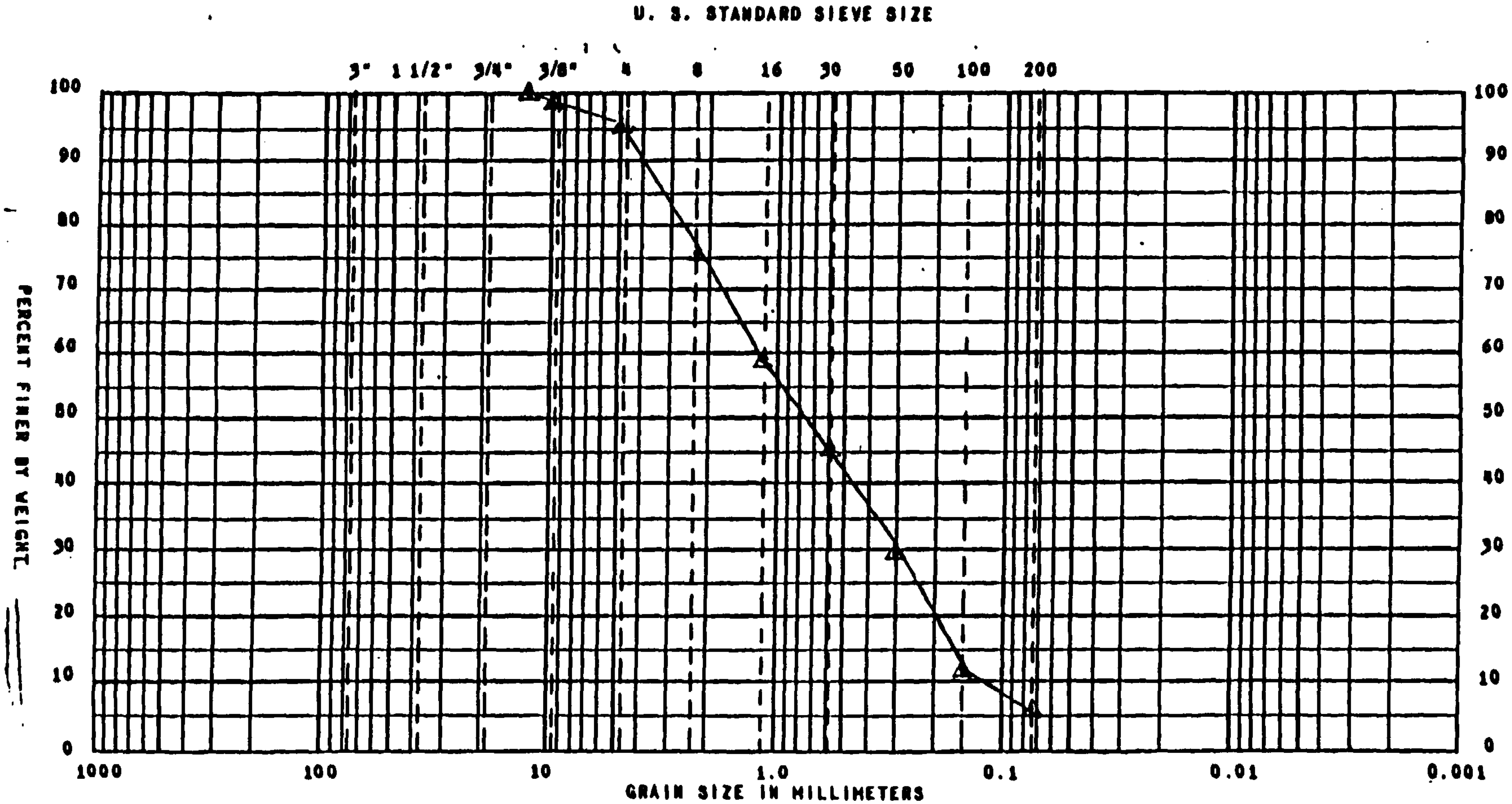
PROJECT Zionsville, Indiana

JOB NUMBER 1626

BORING NUMBER B 5A

SAMPLE NUMBER 92919

DATE 7/8/83



COBBLES	GRAVEL		SAND			SILT OR CLAY
	COARSE	FINE	COARSE	MEDIUM	FINE	

BORING	DEPTH	CLASSIFICATION		NAT. WC	LL	PL	PI	
B 5A	29.5-31.5'	SW	gray f-c sand w/trace gravel and silt					

TECHNICIAN LH

COMPUTED BY LH

CHECKED BY JNS

REMARKS

CH2M HILL

MEMORANDUM

TO: File

DATE: May 31, 1985

RE: ECC Site Remedial Investigation
Groundwater Sampling Program
Subtask 3-2

PROJECT: W65230.C3

INTRODUCTION

A three-phase groundwater sampling program was conducted during 1983 and 1984 at the Environmental Chemical and Conservation Corporation (ECC) site near Zionsville, Indiana. Phase I of the groundwater sampling program was conducted on July 18 and 19, 1983. Phase II of the groundwater sampling program was conducted on November 29 and 30, 1983. Phase III of the groundwater sampling program was conducted on December 13 and 14, 1984. Sampling was performed by personnel from CH2M HILL, with support from Kumar Malhotra and Associates (KMA) during Phase II. This work was performed in partial satisfaction of Contract No. 68-01-6692, Work Assignment No. 18.5L30.0, Subtask 3-2.

PURPOSE

The overall objectives of the groundwater sampling program at the ECC site were to:

- Acquire data that will assist the project team in identifying hazardous substances present at the ECC site.
- Define spacial and temporal groundwater contamination.

The information gathered in the groundwater sampling program will be used in the development of appropriate remedial action alternatives for the ECC site.

SCOPE

The scope of the Phase I groundwater sampling effort at the ECC site included the following:

- Twelve groundwater monitoring well samples
- Two groundwater duplicate samples

- One groundwater field blank

During the first phase sampling efforts, only nine wells were sampled. One well was not sampled because of oil contamination at the water surface. Two onsite monitoring wells were found to be covered with concrete and were inaccessible.

The scope of the Phase II groundwater sampling effort included the following:

- Thirteen groundwater monitoring well samples
- Two groundwater duplicate samples
- One groundwater field blank

During the second phase sampling effort, only 11 wells were sampled. The samples wells included the nine wells sampled in Phase I and two newly installed wells. The well found to be contaminated during the first phase sampling effort was not included in the scope of work for Phase II groundwater sampling. The two onsite monitoring wells were again inaccessible.

The scope of the Phase III groundwater sampling effort included the following:

- Ten groundwater monitoring well samples.

- One groundwater duplicate sample.

- One groundwater field blank.

During the third phase sampling effort, only the wells in the shallow aquifer were sampled. This included the six shallow wells sampled in Phase II and four wells installed in October and November 1984. Due to the slow recharge to the wells, only organic samples were obtained from ECC-9A and ECC-11A.

PERSONNEL

The sampling team during the Phase I sampling effort consisted of personnel from CH2M HILL. The sampling team leader was Dennis Totzke. He was assisted by Jerry Bills, Tom

Gilgenbach and Ike Johnson. Paperwork was maintained by Linda Klann and Shawn Breitenfeldt.

The sampling team during the Phase II sampling effort included personnel from CH2M HILL and KMA. The sampling team leader was Phil Smith from CH2M HILL. He was assisted by Mike Schuetz of CH2M HILL and Charles Brunett and Bob Teerman of KMA. Paperwork was maintained by Phil Smith.

The sampling team during the Phase III sampling effort consisted of personnel from CH2M HILL. The sampling team leader was Mark Lepkowski. He was assisted by Randy Weltzin, Megan Morrison and Jeff Keiser. Paperwork was maintained by Mark Lepkowski and Megan Morrison.

GROUNDWATER SAMPLING PROCEDURE

MONITORING WELL SELECTION

The monitoring wells sampled during this effort were selected by CH2M HILL and were revised by the U.S. EPA and Indiana State Board of Health (ISBH). Seven of the offsite wells were installed in June 1983 by Mateco Drilling Co. The five remaining offsite wells were installed in September 1983 and November 1984 by ATEC Associates, Inc. Two onsite wells, MW1A and MW2A, were installed in November 1975 by the Ottinger Drilling Co. Monitoring well ECC-8A was installed in October 1984 by ATEC Associates.

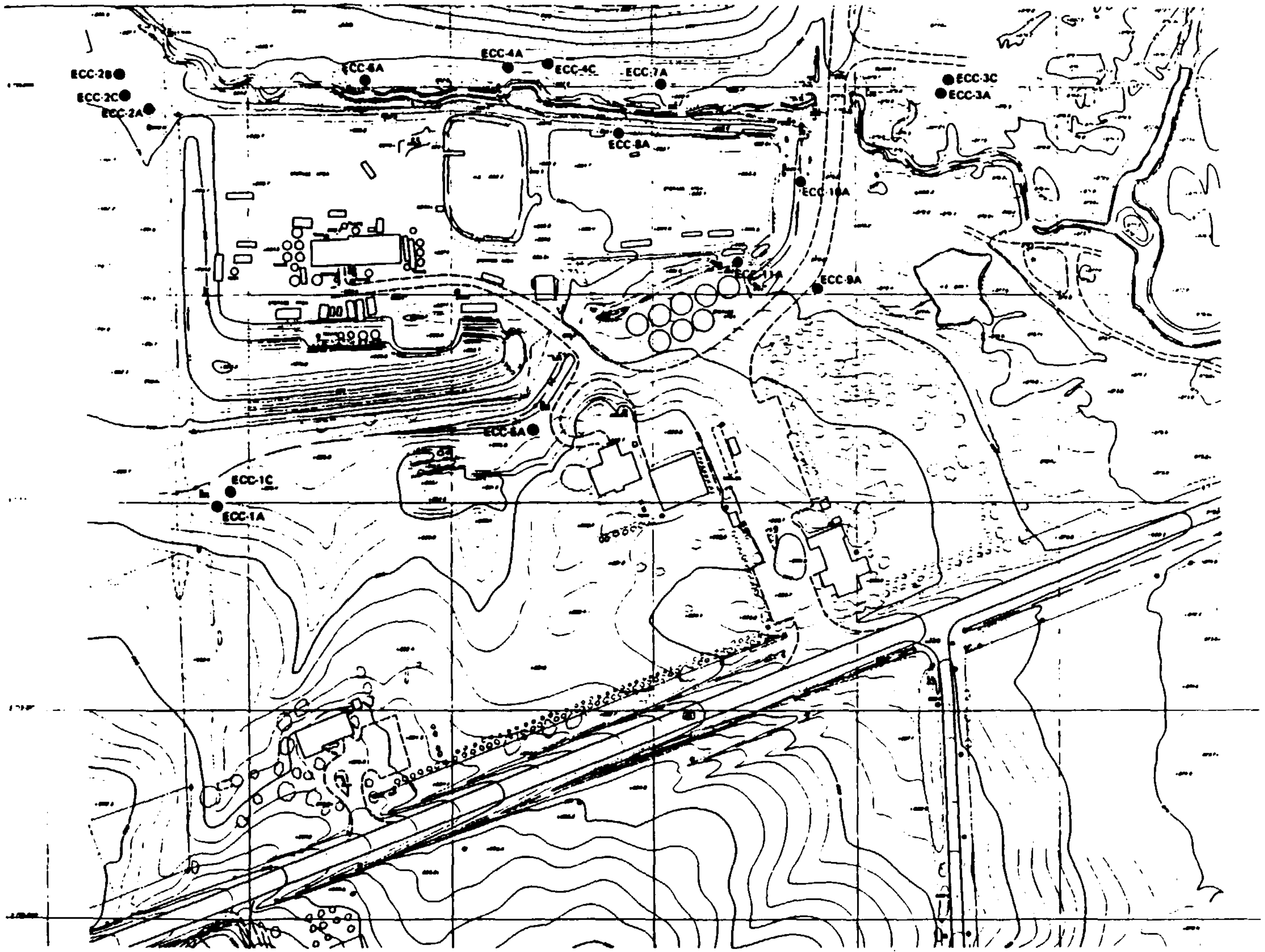
Monitoring wells installed by Mateco Drilling and ATEC were 2-inch diameter wells constructed with PVC piping. The two monitoring wells installed by Ottinger Drilling were 4-inch diameter wells, which were originally developed as industrial supply wells. Well logs were available for all wells before they were sampled.

The locations of all monitoring wells are shown in Figure 1, their description is given in Table 1.

MONITORING WELL SAMPLING

General Well Sampling Strategy

The general well sampling strategy was to obtain a represen-



LEGEND

● ECC-7A REMEDIAL INVESTIGATION MONITORING WELL

NOTE: All well locations are approximate

0 50 100 150 200

SCALE IN FEET

FIGURE 1
MONITORING WELL LOCATIONS
ECC SITE
TM 3-2

Table 1
GROUNDWATER WELL DESCRIPTIONS
ECC SITE

Well Number	Description	Date of Construction
ECC-1A (S/G)	Shallow monitoring well	06/02/83
ECC-1C	Deep monitoring well	06/08/83
ECC-2A "	Shallow monitoring well	
ECC-2B	Intermediate monitoring well	
ECC-2C	Deep monitoring well	06/17/83
ECC-3A	Shallow monitoring well	06/14/83
ECC-3C	Deep monitoring well	06/24/83
ECC-4A	Shallow monitoring well	
ECC-4C	Deep monitoring well	06/21/83
ECC-5A "	Shallow monitoring well	06/24/83
ECC-6A "	Shallow monitoring well	09/01/83
ECC-7A "	Shallow monitoring well	09/01/83
ECC-8A "	Shallow monitoring well	10/26/84
ECC-9A "	Shallow monitoring well	10/31/84
ECC-10A ?	Shallow monitoring well	11/02/84
ECC-11A ?	Shallow monitoring well	11/05/84
MW-1A	Existing onsite monitoring well	
MW-2A	Existing onsite monitoring well	

GLT360/13

Table 1
PHASE 1 - SAMPLE IDENTIFICATION MATRIX SOIL SAMPLES
ECC SITE (Subtask 3-4)

Sample Number	Date Sampled	Date Shipped	Laboratory Service	Airbill Number	OTR	Chain of Custody
AA	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7244	5-4044
AC	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7245	5-4044
AE	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7246	5-4043
AG	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7247	5-4043
AI	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7248	5-4043
AK	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7249	5-4043
AL	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7250	5-4043
AO-SE	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7251	5-4043
AP-SE	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7252	5-4043
N of P	5/9/84	5/16/84	Science Applications, Inc.	411093981	E-7253	5-4041
N of PD	5/9/84	5/16/84	Science Applications, Inc.	411093981	E-7254	5-4041
AM-SW	5/9/84	5/16/84	Science Applications, Inc.	411093981	E-7255	5-4041
AN-O-6	5/9/84	5/16/84	Science Applications, Inc.	411093981	E-7256	5-4041
AE-AH-0-6	5/9/84	5/16/84	Science Applications, Inc.	411093981	E-7257	5-4041
AE-AG-0-6	5/9/84	5/16/84	Science Applications, Inc.	411093981	E-7258	5-4041
B6-0-6	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7259	5-4042
D7-18-20	5/8/84	5/16/84	Science Applications, Inc.	411093981	E-7260	5-4042

tative sample of the local groundwater while minimizing contamination of both the monitoring well and the sample.

Where well sampling equipment was required, the order of well sampling was based upon sampling those wells suspected to be the least contaminated first and moving progressively toward those suspected to be most contaminated.

Well Sampling Equipment

Two types of sampling equipment were used to sample the shallow aquifer wells. A stainless steel submersible pump (Johnson-Keck Model SP-81) was used to purge and pump out all samples except volatile organic samples. A 2-inch stainless steel bailer was used to obtain samples for volatile organics analysis.

No sampling equipment was required for the intermediate and deep monitoring wells, which were flowing artesian wells.

Water Surface and Head Measurements

Before purging the shallow monitoring wells, the location of the groundwater surface was measured. The surface water level was measured with a battery powered water surface level indicator. All measurements were made from the top of the well casing.

Before sampling the intermediate and deep monitoring wells (all artesian), the potentiometric surface was measured by attaching 5-foot lengths of 1-1/4-inch diameter PVC extensions on top of the well casing and measuring the height of the water column upon reaching equilibrium.

Well Purging

Each monitoring well was purged before taking the groundwater sample. The volume of water in each well was calculated based on the total depth of the well and the depth to water surface in the well. The required purge water volume was then set at five times the well water volume.

The routine for well purging with the submersible pump (shallow wells) was based on the constraints of the pump itself. The submersible pump has a normal duty cycle of 15 minutes and an approximate discharge flow rate of 1.0 gpm. After

15 minutes of operation, the pump must be idle for a minimum of 5 minutes for motor cooling. The pump was operated through several duty cycles until the required purge water volume was removed.

During well purging, the pump was periodically moved within the water column from top to bottom to distribute the source of purge suction.

Purge waters from the shallow wells were collected in 55-gallon drums. At the direction of the onscene coordinator (OSC), the drum contents were disposed of in the lagoon on the ECC site by the drum removal contractor, Chem-Waste Management, Inc.

No equipment was required to purge the flowing artesian (intermediate and deep) wells. Water flowing from these monitoring wells was not collected.

<u>Well Sampling</u>

In the Phase II and Phase III sampling efforts, field measurement of temperature, conductivity, and pH were performed before sampling. The results of these field measurements are presented in Tables 2 and 3.

Shallow monitoring wells were sampled with the submersible pump. At these wells, the submersible pump was used to take the samples for base/neutral, acid, and pesticide/PCB organics, metals, and cyanide. Samples were collected by filling the sample bottles directly from the sampling pump discharge line or the bailer. Samples for volatile organic analysis were taken with the stainless steel bailer at shallow monitoring wells.

All samples from deep and intermediate wells were collected directly from the flow at the well head.

All sample fractions for metal analysis were filtered through a 0.45u filter before preservation. Sample fractions for metals were preserved with nitric acid and fractions for cyanide were preserved with sodium hydroxide.

MEMORANDUM

CH2M HILL

TO: File

DATE: May 31, 1985

RE: ECC Site Remedial Investigation
Soil Investigation
RI/FS
Subtask 3-4

PROJECT: W65230.C3

INTRODUCTION

Soil sampling was performed from May 7 through May 9, 1984 and October 22 through October 26, 1984 at the ECC site near Zionsville, Indiana. Sampling was performed by personnel from CH2M HILL with support from Ecology & Environment, Inc., during the May sampling effort. This work was performed in partial satisfaction of Contract No. 68-01-6692, Work Assignment No. 18.5L30.0, Subtask 3-4.

PURPOSE

The purpose of the soil investigation was to collect data on the depth, areal extent and concentrations of hazardous constituents at potential contaminant source areas on the ECC site. An additional objective was to evaluate the dikes and embankments as possible sources of uncontaminated soil that could be used as cover material for potential remedial actions.

SCOPE

The final scope of the initial soil sampling effort at the ECC site included:

- Fifty-eight soil samples collected from hand auger borings and at surface locations.
- Fifty-seven soil samples qualitatively analyzed for total volatile organics in the field office trailer using an OVA.
- Seventeen soil samples sent to the CLP for complete inorganic and organic analysis.

- o Twenty soil samples stored for possible future CLP analysis, geotechnical analysis or responsible party analysis.

The scope of the second sampling effort included:

- o Seventy-seven soil samples collected from nine soil borings.
- o Forty-three soil samples collected from 12 test pits located throughout the site.
- o One hundred-two soil samples qualitatively analyzed for total volatile organics in the office using an OVA (eight samples could not be analyzed because the identification washed off).
- o Thirty-eight soil samples sent to the CLP for complete organic and inorganic analysis.
- o Twenty-seven soil samples stored for possible future CLP analysis, geotechnical analysis, or responsible party analysis.

SAMPLING LOCATION SELECTION

Soil boring samples for the initial soil sampling effort were obtained for contaminant testing from 15 boring locations shown in Figure 1. Locations were chosen based on a 25-foot square grid spacing covering the north drum disposal area and the area between the cooling water pond and the concrete (south) pad. Additional borings were completed along the south dike of the site. Eighteen surficial soil samples were collected at 50-foot intervals along the embankment on the north and west side of the site and in the polymer pit.

Soil samples were obtained in October from the nine boring and 12 test pit locations shown in Figure 2. The ECC site was divided into a number of areas, each containing a specified number of test pit locations, where wastes were known to have been stored, spilled, or mixed in shallow pits. Fewer test pits were placed in areas not suspected of containing significant contamination.

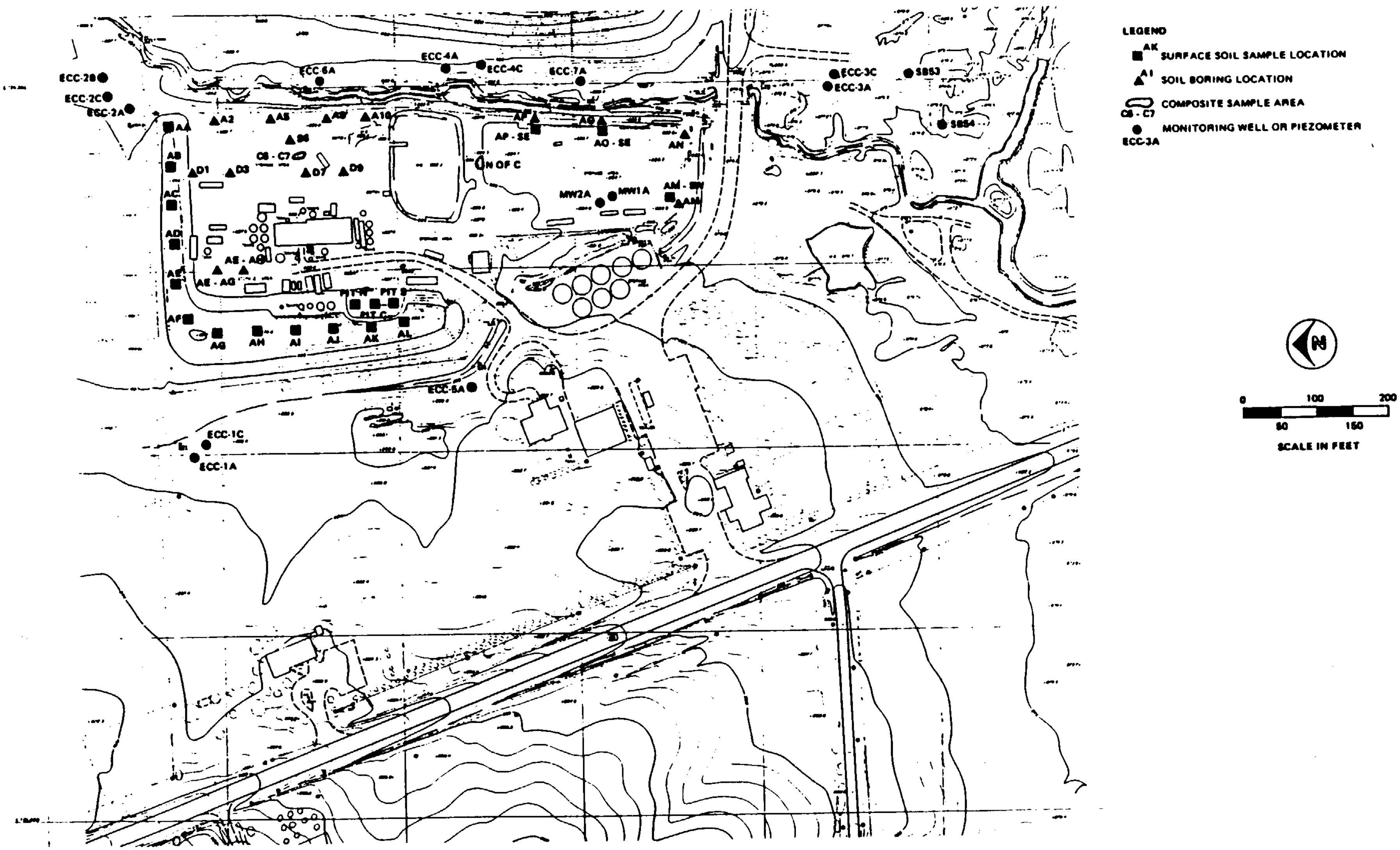


FIGURE 1
PHASE 1 SOIL BORING AND
SURFACE SAMPLE LOCATIONS
ECC SITE
TM 3-4

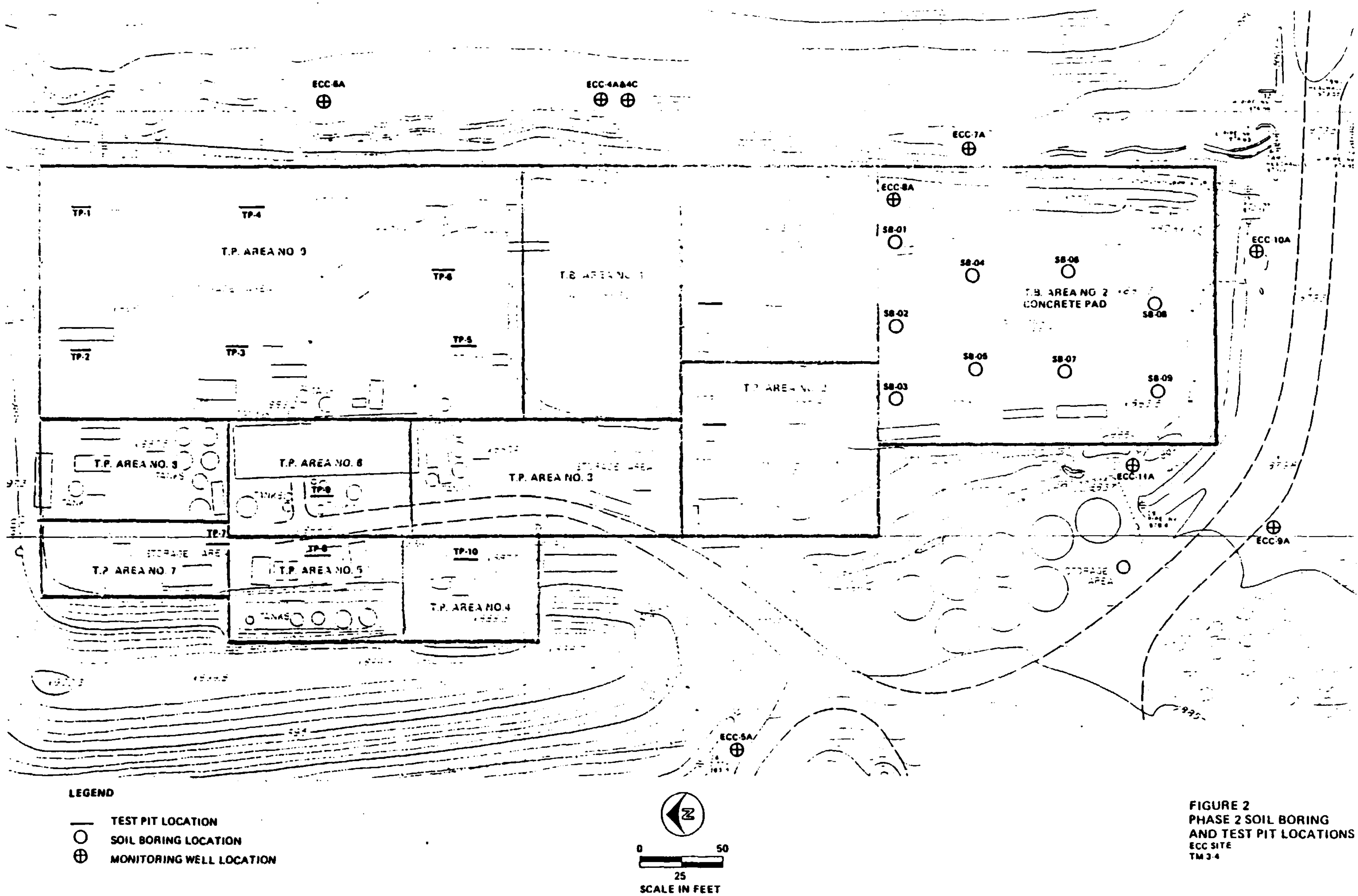


FIGURE 2
PHASE 2 SOIL BORING
AND TEST PIT LOCATIONS
ECC SITE
TM 3-4

INITIAL SAMPLING EFFORT

PERSONNEL

The sampling team consisted of personnel from CH2M HILL and Ecology and Environment, Inc. Sampling team members were:

- Dennis Totzke - Project Manager
- Isaac Johnson - Geotechnical Engineer
- Brad Berggren - Geotechnical Engineer
- Randy Weltzin - Surveyor
- Mark Lepkowski - Sampling Technician
- Pete Gorton - E&E, Site Safety Coordinator
- Russel Short - E&E, OVA Operator

SOIL SAMPLING

The soil sampling was performed from May 7 through May 9, 1984. Weather conditions during the period consisted of clear to overcast skies, temperatures in the 50° to 70°F. range and relatively strong (approximately 20 mph) winds from the west.

Soil borings were made at 15 locations and surficial samples were collected at 20 locations. Borings were not advanced more than 2-1/2 feet below ground surface because of rocks and other debris. Surficial samples were generally no deeper than 6 to 8 inches below ground surface.

Soil samples were collected using 2-inch diameter steel hand augers or stainless steel shovels. Each soil sample was logged and classified by a geotechnical engineer. As part of the sampling procedure, all samples were screened in the field using an organic vapor analyzer (OVA). Samples were also classified in the field as being low or medium concentration. Low concentration samples appeared to be uncontaminated and did not register on the OVA. Medium concentration samples appeared discolored or stained and had OVA readings above background. Soil samples intended for CLP analysis were placed in two 40-ml volatile organic analysis (VOA) jars and one 8-oz glass jar. An additional 40 ml VOA jar was collected for field laboratory screening with an OVA. Samples were shipped to Science Applications, Inc., on May 16, 1984 for organic analysis (Table 1).

PERSONNEL

Surface water and sediment samples were collected by Jerry Bills and Dennis Totzke of CH2M HILL. Paperwork was maintained by Lin Klann and Shawn Breitenfeldt of CH2M HILL.

SURFACE WATER SAMPLING

SAMPLING LOCATION SELECTION

The sampling location selection strategy was to select sampling locations in areas of probable contamination that would help identify the extent of offsite migration of contaminants. The final selection of sampling points was made by CH2M HILL and reviewed by the U.S. EPA and the ISBH.

The work plan for the ECC site recommended that surface water samples be collected in four locations. Four locations were selected for surface water sampling. These locations are identified in Figure 1.

SAMPLE COLLECTION

Surface water samples were collected at mid-depth of the stream with 4-liter stainless steel dippers. A different stainless steel dipper was used to collect each sample.

The blank sample (ECC-SW-BK1-001) was prepared by pouring distilled, deionized water into the sample collection equipment and then into the appropriate sample bottles. The blank water was obtained from the ISBH in Indianapolis.

SAMPLING EFFORT

Five surface water samples were collected from four offsite locations and one blank sample was prepared on July 18, 1983. Samples were packed in accordance with U.S. EPA Contract Laboratory Program (CLP) protocol. The samples were shipped via Federal Express to the assigned CLP labs on the day of sampling. Samples for Tasks 1 and 2 inorganic and Task 3 cyanide analyses were shipped to JTC Environmental Consultants, Inc. in Rockville, Maryland. Samples for organic analyses were shipped to Mead Compu/Chem in Research Triangle Park, North Carolina.

A summary of the sample tracking documentation is given in Table 1. The assigned case number was 1838.

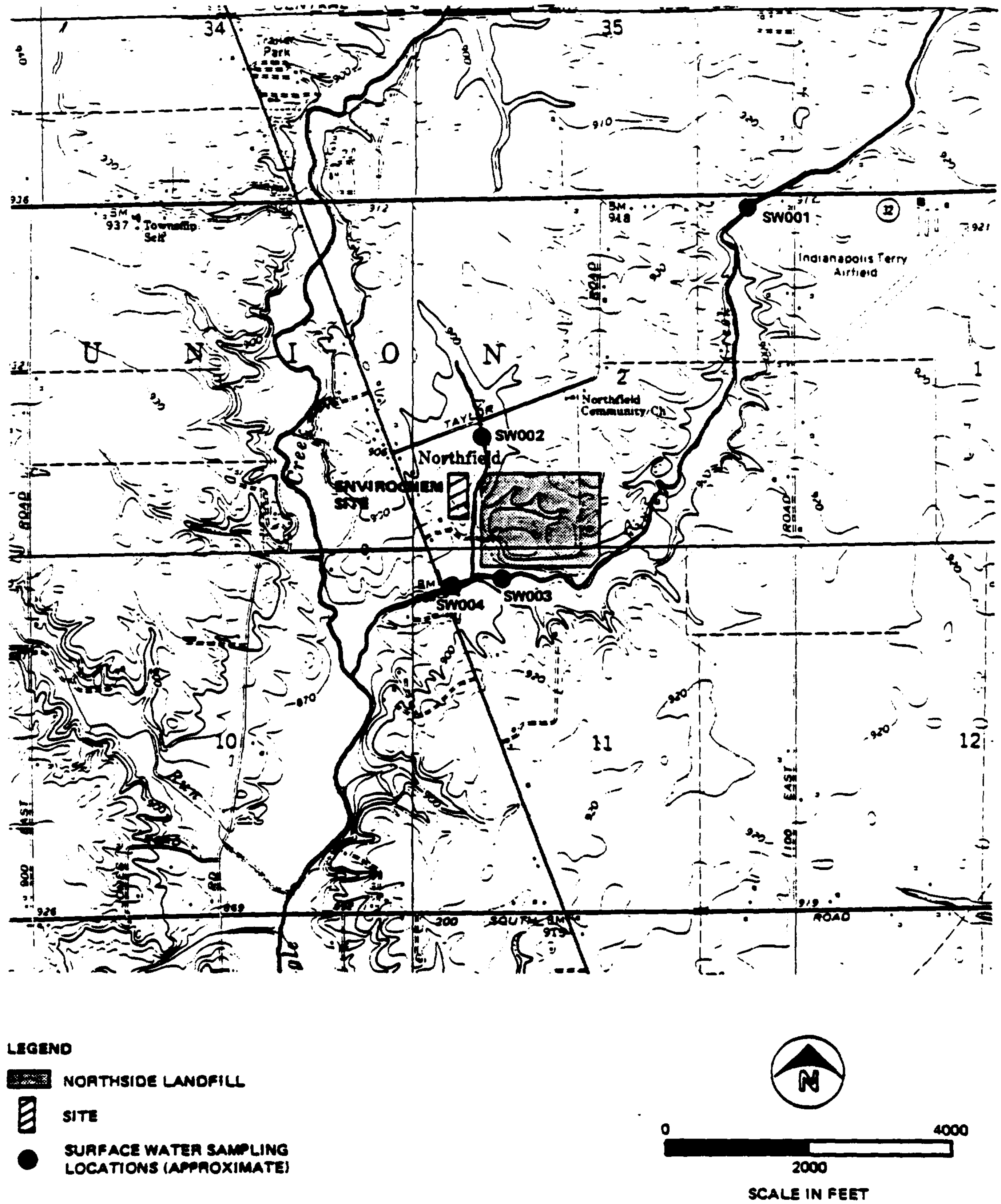


FIGURE 1
SURFACE WATER SAMPLING LOCATIONS
ECC SITE

Table 1
SAMPLE DOCUMENTATION SUMMARY
SURFACE WATER SAMPLING
ECC SITE (SUBTASK 3-3)
CASE NO. 1838

CH2M HILL Sample Number	Date Sampled	Date Shipped	Laboratory Service	Airbill Number	ITR	OTR	Chain-of-Custody
ECC-SW-001-001-2	7/18/83	7/18/83	JTC	322-856-730	MS0277		5-8902
			Mead Compu/Chem	322-856-715		S2377	5-8906
ECC-SW-002-001-2	7/18/83	7/18/83	JTC	322-856-730	MS0278		5-8902
			Mead Compu/Chem	322-856-715		S2378	5-8906
ECC-SW-003-001-2	7/18/83	7/18/83	JTC	322-856-730	MS0279		5-8902
			Mead Compu/Chem	322-856-715		S2379	5-8907
ECC-SW-004-001-2	7/18/83	7/18/83	JTC	322-856-730	MS0280		5-8903
			Mead Compu/Chem	322-856-715		S2380	5-8907
ECC-SW-004-002-2	7/18/83	7/18/83	JTC	322-856-730	MS0281		5-8903
			Mead Compu/Chem	322-856-715		S2381	5-8907
ECC-SW-BK1-001	7/18/83	7/18/83	JTC	322-856-730	MS0282		5-8903
			Mead Compu/Chem	322-856-715		S2382	5-8907

OTR = Organic Traffic Report
ITR = Inorganic Traffic Report

GLT360/17

ANALYTICAL RESULTS

Inorganic analytical results for surface water samples are presented in Table 2. Quality assurance (QA) data indicate poor or marginal recovery in the spiked samples containing aluminum, tin and thallium. Zinc, boron, and tin were detected in the laboratory method blank. Mercury was detected in the field blank.

Organic analytical results appear in Table 3. For organic constituents, only those CLP hazardous substance list (HSL) compounds detected in surface water samples are listed. Table 4 provides a complete list of the organic HSL compounds that were tested for in each sample. Table 5 lists compounds that were tentatively identified using GC/MS techniques. Compounds listed in Table 5 were estimated and had purities exceeding 90 percent.

The QA review classified base/neutral analyses as semiquantitative because of low average surrogate recoveries. Volatiles were held beyond the acceptable time for analysis but the results were determined to be acceptable due to good QA analytical results. The acid analyses were classified as qualitative due to low surrogate recoveries. Because of very low surrogate recoveries, TCDD data were determined to be unacceptable.

No effort has been made to evaluate the analytical results. Evaluation of site investigation data will be performed in Task 4 of the RI and discussed in the RI report.

SEDIMENT SAMPLING

SAMPLING LOCATION SELECTION

The sampling location selection strategy was to select sampling locations in areas of probable contamination that would help identify the extent of offsite migration of contaminants. The final selection of sampling points was made by CH2M HILL and reviewed by the U.S. EPA and the ISBH.

The work plan for the ECC site recommended that samples be collected in six locations. Four of the locations matched surface water sampling locations. Sampling locations are identified in Figure 2.

EPA QA review classified base/neutral and pesticide analyses of sediment samples as semiquantitative due to low surrogate recoveries. Although holding times for volatile samples were beyond acceptable limits, volatile analyses were classified as quantitative because of good QA analytical results. The acid analyses were classified as qualitative because of low surrogate recoveries. The TCDD data were determined to be unacceptable because of very low surrogate recoveries.

No effort has been made to evaluate the analytical results. Evaluation of site investigation data will be performed in Task 4 of the RI and discussed in the RI report.

GLT424/60

SAMPLE COLLECTION

Sediment samples were collected with a 2-inch diameter stainless steel Wildco core sampler. Samples consisted of a composite of 1-inch to 3-inch long cores taken within a 10-foot square area. Six to fifteen cores were required to make one composite sample.

The blank sample (ECC-SD-BK1-001) was prepared by pouring reagent grade diatomaceous earth into a decontaminated core tube, extruding the diatomaceous earth from the tube and placing it into a sample bottle.

SAMPLING EFFORT

Eight sediment samples were collected from six offsite locations on July 19, 1983. Samples were packed in accordance with U.S. EPA CLP protocol. The samples were shipped via Federal Express on July 21, 1983. Samples were stored on ice in Coleman coolers while awaiting shipment. Samples for Tasks 1 and 2 inorganic analyses and Task 3 cyanide were shipped to U.S. Testing Company, Inc. in Hoboken, New Jersey. Samples for organic analyses were sent to Mead Compu/Chem in Research Triangle Park, North Carolina.

A summary of the sample tracking documentation is given in Table 6. The assigned case number was 1838.

ANALYTICAL RESULTS

Inorganic analytical results for sediment samples are presented in Table 7. Moisture contents determined during the organic analysis were used to change concentrations of inorganics to concentration per dry unit weight. Sample quantities were insufficient to make moisture content determinations for samples SD-004, SD-004 duplicate, and the blank. QA review indicates that calibration data for inorganic analyses was insufficient to establish positive quality control. These data are preliminary pending further verification.

Organic analytical results appear in Table 8. For organic constituents, only those CLP HSL compounds detected in sediment samples are listed. Table 4 provides a complete list of the organic HSL compounds that were tested for in each sample. Table 9 lists compounds that were tentatively identified using GC/MS techniques. Compounds in Table 9 were estimated and had a purity exceeding 90 percent.

Table 4 (Page 1 of 4)
ORGANIC ANALYSIS LIST
ECC SITE

Constituent

ACID COMPOUNDS[a]

2,4,6-trichlorophenol
p-chloro-m-cresol
2-chlorophenol
2,4-dichlorophenol
2,4-dimethyl phenol
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
4,6-dinitro-2-methy phenol
pentachlorophenol
phenol

BASE/NEUTRAL COMPOUNDS

acenaphthene
benzidine
1,2,4-trichlorobenzene
hexachlorobenzene
hexachloroethane
bis(2-chloroethyl)ether
2-chloronaphthalene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3'-dichlorobenzidine
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
fluoranthene
4-chlorophenyl phenyl ether
4-bromophenyl phenyl ether
bis(2-chloroisopropyl)ether
bis(2-chloroethoxy)methane
hexachlorobutadiene
hexachlorocyclopentadiene
isophorone
naphthalene
nitrobenzene
N-nitrosodiphenylamine

Table 4 (Page 2 of 4)

Constituent

BASE/NEUTRAL COMPOUNDS (continued)

N-nitrosodipropylamine
bis(2-ethylhexyl)phthalate
benzyl butyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate
diethyl phthalate
dimethyl phthalate
benzo(a)anthracene
benzo(a)pyrene
benzo(b)fluoranthene
benzo(k)fluoranthene
chrysene
acenaphthylene
anthracene
benzo(ghi)perylene
fluorene
phenanthrene
dibenzo(a,h)anthracene
indeno(2,3,3-cd)pyrene
pyrene

VOLATILES

acrolein
acrylonitrile
benzene
carbon tetrachloride
chlorobenzene
1,2-dichloroethane
1,1,1-trichloroethane
1,1-dichloroethane
1,1,2-trichloroethane
1,1,2,2-tetrachloroethane
chloroethane
2-chloroethylvinyl ether
chloroform
1,1-dichloroethene
trans-1,3-dichloropropene
cis-1,3-dichloropropene
ethylbenzene
methylene chloride

Constituent

VOLATILES (continued)

chloromethane
bromomethane
bromoform
bromodichloromethane
fluorotrichloromethane
dichloridifluoromethane
chlorodibromomethane
tetrachloroethene
toluene
trichloroethene
vinyl chloride

NONPRIORITY POLLUTANTS HAZARDOUS SUBSTANCES

benzoic acid
2-methylphenol
4-methylphenol
2,4,5-trichlorophenol
aniline
benzyl alcohol
4-chloroaniline
dibenzofuran
2-methylnaphthalene
2-nitroaniline
3-nitroaniline
4-nitroaniline
acetone
2-butanone
carbondisulfide
2-hexanone
4-methyl-2-pentanone
styrene
vinyl acetate
o-xylene

PESTICIDES[b]

aldrin
dieldrin
chlordane
4,4'-DDT
4,4'-DDE
4,4'-DDD

Constituent

PESTICIDES (continued)

a-endosulfan
b-endosulfan
endosulfan sulfate
endrin
endrin aldehyde
heptachlor
heptachlor epoxide
a-BHC
b-BHC
d-BHC
g-BHC (lindane)
PCB-1242
PCB-1254
PCB-1221
PCB-1232
PCB-1248
PCB-1260
PCB-1016
toxaphene

DIOXINS[c]

2,3,7,8-tetrachloro-dibenzo-p-dioxin

---

[a] QA data indicate that these analyses are qualitative due to low surrogate recoveries. Existing detection limits may not reflect attainable precision.
[b] QA data indicate that analytical results for pesticides in sediment samples are semiquantitative because of low recoveries in spiked samples.
[c] QA data indicate that analytical results for TCDD are unacceptable.

GLT360/16

Table 5
TENTATIVELY IDENTIFIED COMPOUNDS
SURFACE WATER SAMPLES
ECC SITE (SUBTASK 3-3)
CASE NO. 1838

Compound[a]	SW-001	SW-002	SW-003	SW-004	SW-004 (Duplicate)	Blank
Volatiles						
1,1,1-trichloro-1,2,2-trifluoroethane				13	14	
trichloroethene				6.9		
2,3,4-trimethylhexane				14		
2,4-dimethylheptane				22		
1,4-dioxane				10		
tetrahydrofuran						7.1

[a]Concentrations expressed as ug/l.

GLT360/22

Table 6
SAMPLE DOCUMENTATION SUMMARY
SEDIMENT SAMPLING
ECC SITE (SUBTASK 3-3)
CASE NO. 1838

CH2M HILL Sample Number	Date Sampled	Date Shipped	Laboratory Service	Airbill Number	ITR	OTR	Chain-of-Custody
ECC-SD-001-001	7/19/84	7/21/83	U.S. Testing	322-856-623	MS0289		5-8914
			Mead Compu/Chem	322-856-634		S2389	5-8913
ECC-SD-002-001	7/19/84	7/21/83	U.S. Testing	322-856-623	MS0290		5-8914
			Mead Compu/Chem	322-856-634		S2390	5-8913
ECC-SD-003-001	7/19/83	7/21/83	U.S. Testing	322-856-623	MS0291		5-8914
			Mead Compu/Chem	322-856-634		S2391	5-8913
ECC-SD-004-001	7/19/83	7/21/83	U.S. Testing	322-856-623	MS0292		5-8914
			Mead Compu/Chem	322-856-634		S2392	5-8913
ECC-SD-004-002	7/19/83	7/21/83	U.S. Testing	322-856-623	MS0296		5-8914
			Mead Compu/Chem	322-856-623		S2395	5-8913
ECC-SD-005-001	7/19/83	7/21/83	U.S. Testing	322-856-623	MS0293		5-8914
			Mead Compu/Chem	322-856-634		S2393	5-8913
ECC-SD-006-001	7/19/83	7/21/83	U.S. Testing	322-856-623	MS0294		5-8914
			Mead Compu/Chem	322-856-634		S2394	5-8913
ECC-SD-BK1-001	7/19/83	7/21/83	U.S. Testing	322-856-623	MS0295		5-8914
			Mead Compu/Chem	322-856-634		S2396	5-8913

OTR = Organic Traffic Report
ITR = Inorganic Traffic Report

GLT360/18

Table 7
INORGANIC ANALYTICAL RESULTS
SEDIMENT SAMPLES ECC SITE (SUBTASK 3-3)
CASE NO. 1838

Compound[a]	SD-001	SD-002	SD-003	SD-004	SD-004 (Duplicate)	SD-005	SD-006	Blank
Aluminum	2,172	9,744	4,326	2,890	3,050	5,928	2,850	200
Chromium	4	13	13	5	6	11	<5.7	9
Barium	45	102	44	31	35	66	27	<5
Beryllium	<0.45	0.6	<0.48	<0.25	<0.25	<0.57	<0.57	<0.25
Cobalt	<4.5	<12	5.3	<4	16	<9	<5.7	<2.5
Copper	7	23	19	13	16	23	9	<2.5
Iron	8,598	18,624	12,415	8,900	8,080	18,696	9,257	120
Nickel	<4	21	13	11	10	23	<11	<2
Manganese	161	499	275	170	158	413	239	<0.75
Zinc	<29	75	52	33	39	64	<30	<2
Boron	<9	<10	<10	<5	<5	<11	<11	<5
Vanadium	<18	23	<19	<10	<10	<23	<23	<18
Silver	<0.9	<1	<1	<0.5	<0.5	<1.1	<1.1	<0.5
Arsenic	<0.9	<1	<1	<0.5	<0.5	<1.1	<1.1	<0.5
Antimony	<2	<2	<2	<1	<1	<2	<2	<1
Selenium	<0.2	<0.2	<0.2	<0.1	<0.1	<0.2	<0.2	<0.1
Thallium	<0.9	<1	<1	<0.5	<0.5	<1.1	<1.1	<0.5
Mercury	<0.02	<0.02	2.25	<0.01	0.02	0.05	0.05	0.04
Tin	<2	<2	<2	<1	<1	<2	<2	<1
Cadmium	1.65[c]	2.3	1.83[c]	0.82[c]	0.78[c]	1.41[c]	1.30[c]	0.26[c]
Lead	19.0	11.5	31.3	17.5	32.3	48	6.8	1.9[c]
Cyanide	33	<19	38	<10	196	73	<23	<10
Percent Moisture	45	48	48	-[b]	-[b]	56	44	-[b]

[a] Concentrations expressed as mg/kg per dry unit weight except SD-004 and SD-004 duplicate.
[b] Sample quantities were insufficient to determine moisture content.
[c] QA review indicates that these data should be regarded as qualitative indication of the presence of these metals because the concentrations are below the lowest quantitative standard.

GLT360/20

Table 8
ORGANIC ANALYTICAL RESULTS
SEDIMENT SAMPLING
ECC SITE (SUBTASK 3-3)
CASE NO. 1838

Compound[a]	SD-001	SD-002	SD-003	SD-004[b]	SD-004[b] (Duplicate)	SD-005	SD-006	Blank
Base/Neutral Compounds								
bis(2-ethylhexyl)phthalate						912		
benzo(a)anthracene				440[c]				
benzo(a)pyrene				< 800[c]				
benzo(b)fluoranthene				< 800[c]				
benzo(k)fluoranthene				< 800[c]				
chrysene				440[c]				
benzo(ghi)perylene				< 800[c]				
dibenzo(a,h)anthracene				< 800[c]				
indeno(1,2,3-cd)pyrene				< 800[c]				
Volatiles								
methylene chloride	< 4.5	< 4.8	6.1	2.5	< 3	9.1	< 4.4	< 3.6
fluorotrichloromethane		< 4.8						
Nonpriority Pollutants/ Hazardous Substances								
benzoic acid				< 4,000				
4-methylphenol				960	680			

[a] Concentrations expressed as ug/kg per dry unit weight except SD-004 and SD-004 duplicate.
[b] Concentrations reported per wet unit because sample quantities were insufficient to determine dry unit weight.
[c] Base/neutral analysis results were determined to be semiquantitative due to low recoveries in surrogate samples.

Table 9
TENTATIVELY IDENTIFIED COMPOUNDS
SEDIMENT SAMPLING
ECC SITE (SUBTASK 3-3)
CASE NO. 1838

Compound[a]	SD-001	SD-002	SD-003	SD-004	SD-004 (Duplicate)	SD-005	SD-006	Blank
Base/Neutral Compounds[b]								
dichloromethane							170	
2-methyl-1-pentene							860	
1,3-dimethylbenzene			310					

[a] Concentrations expressed as ug/kg.
[b] Base/neutral analysis results were determined by QA reviewers to be semiquantitative due to low recoveries in surrogate samples.

GLT360/24

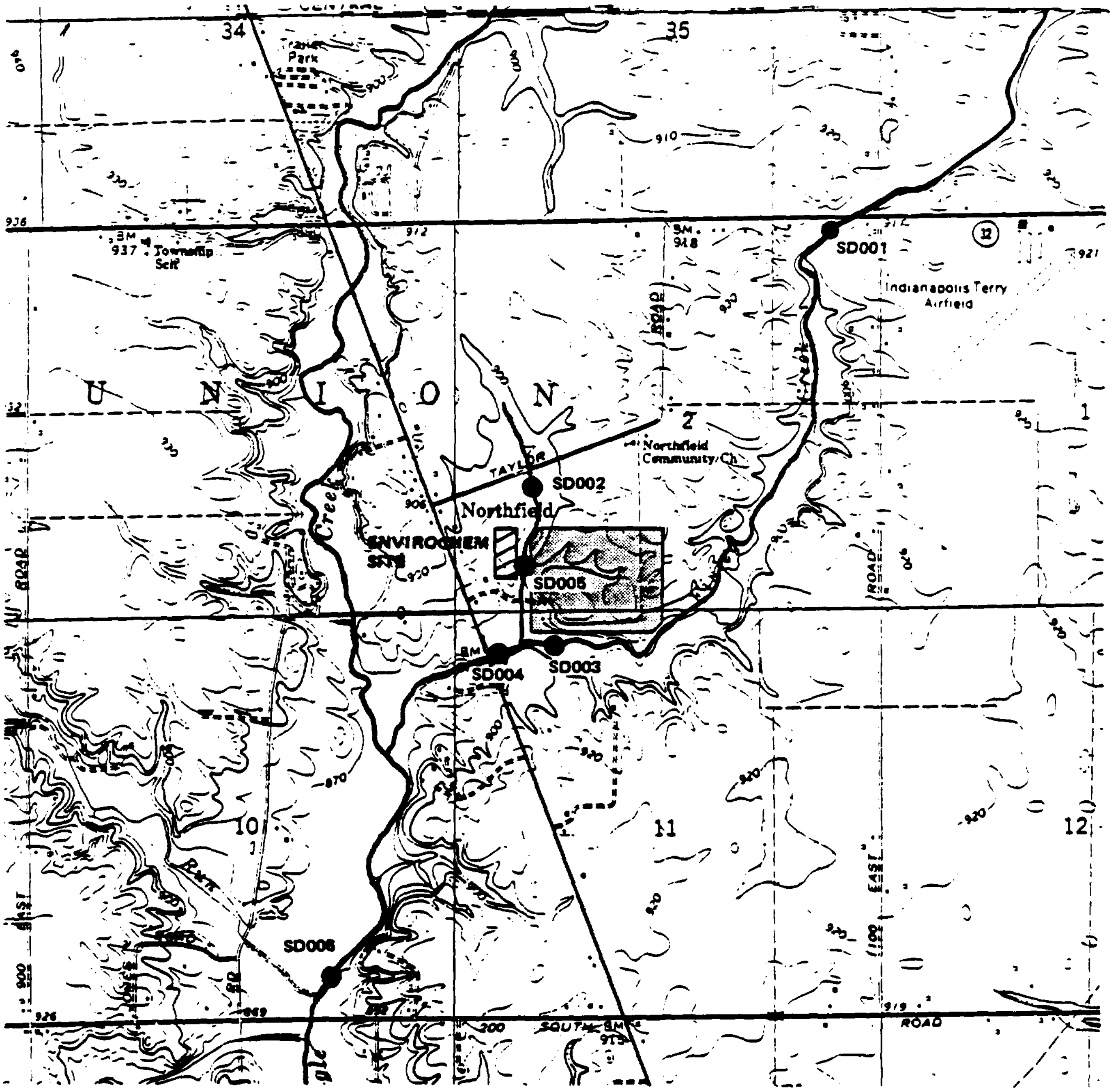


FIGURE 2
SEDIMENT
SAMPLING LOCATIONS
ECC SITE

Table 2
INORGANIC ANALYTICAL RESULTS
SURFACE WATER SAMPLES
ECC SITE (SUBTASK 3-3)
CASE NO. 1838

Compound	SW-001	SW-002	SW-003	SW-004	SW-004 (Duplicate)	Blank
Aluminum[b]	ND	3,050	340	490	440	ND
Chromium	ND	ND	ND	ND	ND	ND
Barium	ND	ND	ND	ND	180	ND
Berykkuyn	ND	ND	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND
Copper	ND	ND	ND	ND	ND	ND
Iron	280	4,460	890	1,410	1,420	ND
Nickel	47	ND	ND	ND	ND	ND
Manganese	190	580	76	130	130	ND
Zinc[c]	ND	ND	ND	ND	ND	ND
Boron[c]	ND	ND	ND	ND	ND	ND
Vanadium	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND
Arsenic	ND	ND	ND	ND	ND	ND
Antimony	ND	ND	ND	ND	ND	ND
Selenium	ND	ND	6	ND	ND	ND
Thallium[b]	ND	ND	ND	ND	ND	ND
Mercury	ND	ND	0.2[d]	0.4[d]	0.3[d]	0.2
Tin[b,c]	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	ND	ND	ND
Cyanide	0.007	0.013	0.005	0.008	0.013	ND

[a] Concentrations expressed as ug/L.
[b] QA data indicate poor or marginal recovery of these spiked metals.
[c] QA data indicate the presence of these metal contaminants in the laboratory method blank.
[d] This metal also detected in the analysis of the field blank.

ND = Not detected.

Table 3
ORGANIC ANALYTICAL RESULTS
SURFACE WATER SAMPLES
ECC SITE (SUBTASK 3-3)
CASE NO. 1838

Compound[a]	SW-001	SW-002	SW-003	SW-004	SW-004 (Duplicate)	Blank
Base/Neutral Compounds						
bis(2-ethylhexyl)phthalate		< 20[b]				
Volatiles[c]						
1,1,1-trichloroethane				120	110	
1,1-dichloroethane				45	45	
chloroethane				12	12	
1,2-transdichloroethene				330	330	
methylene chloride	< 5	< 5	< 5	< 5	< 5	3,100
tetrachlorethene				< 5	< 5	
trichloroethene				67	68	
vinyl chloride				10	11	
Nonpriority Pollutants/ Hazardous Substances						
o-xylene				< 5	< 5	

[a] Concentrations expressed as ug/l.
[b] QA review identified base/neutral results as semiquantitative because the average surrogate recovery is <40 percent.
[c] QA review identified the volatile results acceptable due to good QA analytical results despite the fact that the analyses were run after expiration of the acceptable holding period.

GLT360/21

MEMORANDUM

CH2M HILL

TO: File

DATE: September 7, 1984

RE: ECC Site Remedial Investigation
Surface Water and Sediment Sampling
Subtask 3-3

PROJECT: W65230.C3

INTRODUCTION

Surface water and sediment samples were collected on July 18 and 19, 1983, in the vicinity of the Environmental Chemical and Conservation Corporation (ECC) site in Zionsville, Indiana. Sampling was performed offsite by personnel from CH2M HILL. This work was performed in partial fulfillment of Contract No. 68-01-6692, Work Assignment No. 18.5L30.0, Subtask 3-3.

PURPOSE

The purpose of the surface water and sediment sampling program was to gather data to determine the extent of contamination in the unnamed ditch east of the site, Finley Creek, and Eagle Creek. Previous Indiana State Board of Health (ISBH) sampling efforts have indicated possible contamination of the offsite surface water and sediment. Data obtained in this task will be used in determining if offsite remedial measures are required at the ECC site.

SCOPE

The scope of the surface water and sediment sampling program included the following samples:

- Four surface water samples
- One surface water duplicate sample
- One surface water field blank
- Six sediment samples
- One sediment duplicate sample
- One sediment field blank

16 percent. No tin was found in these samples. The detection limit listed does not reflect the actual sample detection limit.

Organic analyses of Case No. 1838 (Phase I) are semiquantitative for base/neutrals as noted due to surrogate recovery values. Volatiles for this case were held beyond the acceptable time prior to analysis but acceptable analytical QA renders the data useful. Organic analysis for Case No. 2197 (Phase II) shows several compounds as blank contaminants. Methylene chloride and acetone may be of laboratory origin.

Results for acids in both cases were judged by the QA reviewer to be qualitative due to poor or erratic recoveries of spiked compounds. TCDD results were judged to be biased low for Case No. 2197 and unacceptable for Case No. 1838.

Case 3606 (Phase III) organic analysis results for acetone and 2-butanone are semi-quantitative because of low response factors in the standard runs. Based on average surrogate precent recovery and coeeficient of variation, volatiles are quantitative and acid, base neutrals are qualitative.

Evaluation of the analytical results from groundwater samples collected in both sampling efforts will be performed in Task 4 of the RI and discussed in the RI report.

GLT360/12

Table 14
GROUNDWATER TENTATIVELY IDENTIFIED COMPOUNDS - PHASE I
ECC SITE (SUBTASK 3-2)

Compound[a]	1A-001	1C-001	2A-001	2B-001	2C-001	3A-001	3A-002	3C-002	4C-001	4C-002	5A-001	Blank
1,1'-oxybisethane							13					
2-methyl-2-butanol			4.2				4.2				5.8	
tetrahydrofuran												3.8
triphenylester phosphoric acid											6.0	

[a]Concentrations are expressed as ug/l.

GLT360/15

Constituent

VOLATILES (continued)

chloromethane
bromomethane
bromoform
bromodichloromethane
fluorotrichloromethane
dichloridifluoromethane
chlorodibromomethane
tetrachloroethene
toluene
trichloroethene
vinyl chloride

NONPRIORITY POLLUTANTS HAZARDOUS SUBSTANCES

benzoic acid
2-methylphenol
4-methylphenol
2,4,5-trichlorophenol
aniline
benzyl alcohol
4-chloroaniline
dibenzofuran
2-methylnaphthalene
2-nitroaniline
3-nitroaniline
4-nitroaniline
acetone
2-butanone
carbondisulfide
2-hexanone
4-methyl-2-pentanone
styrene
vinyl acetate
o-xylene

PESTICIDES[b]

aldrin
dieldrin
chlordane
4,4'-DDT
4,4'-DDE
4,4'-DDD

<u>Constituent</u>

PESTICIDES (continued)

a-endosulfan
b-endosulfan
endosulfan sulfate
endrin
endrin aldehyde
heptachlor
heptachlor epoxide
a-BHC
b-BHC
d-BHC
g-BHC (lindane)
PCB-1242
PCB-1254
PCB-1221
PCB-1232
PCB-1248
PCB-1260
PCB-1016
toxaphene

DIOXINS[c]

2,3,7,8-tetrachloro-dibenzo-p-dioxin

---

[a] QA data indicate that these analyses are qualitative due to low surrogate recoveries. Existing detection limits may not reflect attainable precision.
[b] QA data indicate that analytical results for pesticides in sediment samples are semiquantitative because of low recoveries in spiked samples.
[c] QA data indicate that analytical results for TCDD are unacceptable.

GLT360/37

Table 13 (Page 1 of 4)
ORGANIC ANALYSIS LIST
ECC SITE

Constituent

ACID COMPOUNDS[a]

2,4,6-trichlorophenol
p-chloro-m-cresol
2-chlorophenol
2,4-dichlorophenol
2,4-dimethyl phenol
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
4,6-dinitro-2-methy phenol
pentachlorophenol
phenol

BASE/NEUTRAL COMPOUNDS

acenaphthene
benzidine
1,2,4-trichlorobenzene
hexachlorobenzene
hexachloroethane
bis(2-chloroethyl)ether
2-chloronaphthalene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3'-dichlorobenzidine
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
fluoranthene
4-chlorophenyl phenyl ether
4-bromophenyl phenyl ether
bis(2-chloroisopropyl)ether
bis(2-chloroethoxy)methane
hexachlorobutadiene
hexachlorocyclopentadiene
isophorone
naphthalene
nitrobenzene
N-nitrosodiphenylamine

Table 13 (Page 2 of 4)

Constituent

BASE/NEUTRAL COMPOUNDS (continued)

N-nitrosodipropylamine
bis(2-ethylhexyl)phthalate
benzyl butyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate
diethyl phthalate
dimethyl phthalate
benzo(a)anthracene
benzo(a)pyrene
benzo(b)fluoranthene
benzo(k)fluoranthene
chrysene
acenaphthylene
anthracene
benzo(ghi)perylene
fluorene
phenanthrene
dibenzo(a,h)anthracene
indeno(2,3,3-cd)pyrene
pyrene

VOLATILES

acrolein
acrylonitrile
benzene
carbon tetrachloride
chlorobenzene
1,2-dichloroethane
1,1,1-trichloroethane
1,1-dichloroethane
1,1,2-trichloroethane
1,1,2,2-tetrachloroethane
chloroethane
2-chloroethylvinyl ether
chloroform
1,1-dichloroethene
trans-1,3-dichloropropene
cis-1,3-dichloropropene
ethylbenzene
methylene chloride

Table 10
GROUNDWATER ORGANIC ANALYTICAL RESULTS - PHASE I
ECC SITE (SUBTASK 3-2)
CASE NO. 1838

Compound[a]	S/G S2383 1A-001	S2370 1C-001	S/G S2384 2A-001	S2371 2B-001	S2372 2C-001	TILL S2388 3A-001	S2373 3A-002	S2374 3C-001	S2375 4C-001	S2375 4C-002	S/G S2386 5A-001	S2346 BK-001
BASE/NEUTRAL COMPOUNDS[b]												
fluoranthene							<20					
isophorone						<20	<20					
chrysene							<20					
pyrene							30					
diethylphthalate							<20					
VOLATILES[c]												
1,1,1-trichloroethane						<5						
1,1-dichloroethane						96	86					
chloroethane						120	116					
trans-1,2-dichloroethene						19	16					
methylene chloride						8		<5				34
trichloroethene						9	7					
vinyl chloride						7	6					
NONPRIORITY POLLUTANTS HAZARDOUS SUBSTANCES												
acetone			640		<100	1,400	1,400				490	
styrene					<5							
o-xylene			9									

[a] Expressed as ug/l
[b] QA data indicate the average surrogate recovery is <40% and these results are semiquantitative.
[c] QA data indicate that these analyses were run after expiration of the acceptable holding period, however they are considered acceptable due to good analytical QA results.

GLT360/10

Table 11
GROUNDWATER ORGANIC ANALYTICAL RESULTS - PHASE II
ECC SITE (SUBTASK 3-2)
CASE NO. 2197

Compound[a]	S/G S2803 1A-01	S2801 1A-02	S2802 1C-01	S/G S2804 2A-01	S2805 2B-01	S2806 2C-01	TILL S2807 3A-01	S2808 3C-01	S2809 4C-01	S/G S2810 5A-01	S/G S2811 6A-01	S/G S2812 7A-01	S/G S2813 7A-02	S2814 Blank
BASE/NEUTRAL COMPOUNDS														
bis(3-ethylhexyl)phthlate		<23												
VOLATILES														
benzene							<9							
1,1-dichloroethane							51.2							
chlorethane							40.7							
chloroform							<9							
trans-1,2-dichloroethene							<9							
methylene chloride	<9	<9	<9	11.0	<9	<9	18	12.4	<9	9.0	19.5	16.5	9.0	9.0[b]
fluorotrichloromethane														11.6
tetrachloroethene	<9	<9		<9						9.0				
toluene														<9
trichloroethene	<9	<9					<9			<9				
vinyl chloride							85.8							
NONPRIORITY POLLUTANTS HAZARDOUS SUBSTANCES														
acetone	9,749	9,897	<9	3,016	<9	<9	15,030	550.7	<9	54.5	4,284	23.9	38.3	<9[b]
2-butanone	<9													
o-xylene							12					<9		

[a]Expressed as ug/l
[b]QA data indicate that these compounds may have originated as laboratory contaminants.

GLT360/11

Table 12
GROUNDWATER ORGANIC RESULTS - PHASE III (ug/L)
ECC SITE (SUBTASK 3-2)
CASE NO. 3606

Compound	E7485 11A-001	E7486 5A-001	E7487 9A-001	E7488 10A-001	E7489 3A-001	E7490 7A-001	E7491 6A-001	E7492 2A-001	E7493 1A-001	E7494 5A-001	E7495 8A-001	E7496 BLANK
	5/6 ?	5/6				5/6	5/6	5/6	5/6	5/6	5/6	
BASE/NEUTRAL COMPOUNDS												
Bis (2-ethylhexyl)phthalate												59
VOLATILES												
benzene					4 J	4 J						
1,1,1-trichloroethane											7	
chloroethane				29		90						
chloroform							3 JB					6
1,1-dichloroethane				8	10	9					6	
trans-1,2-dichloroethane	4000			3 J	3 J						13	
ethylbenzene					3 J	4 J						
methylene chloride		3 J	2 J	4 J	7	3 J		3 J	22	4 J	64	
chloromethane					100							
trichloroethene	28000		3 J								21	
acetone			41B	53B			24B				52B	180
2-butanone				26B								10

FOOTNOTES:

B Analyte has been found in the laboratory blank as well as the sample. Indicates probable contamination.

J Indicates an estimated value. When the mass spectral data indicates the presence of a compound that meets the identification criteria and the result is less than the specified detection limit but greater than zero.

Blanks indicate not detected.

GLT360/59

Table 6
Groundwater Sample Identification Matrix - Phase III
ECC Site (Subtask 3-2)

Case Number	Well Number	Sample	Date Sampled	Date Shipped	Lab Service	Airbill Number	ITR	OTR	Chain of Custody
3606	1A	GW-001	12/13/84 12/13/84	12/13/84 12/13/84	Chemtech* Compu/Chem**	431403206 431403210	ME4629	E7493	504765 504763
3606	2A	GW-002	12/13/84 12/13/84	12/13/84 12/13/84	Computech Compu/Chem	431403206 431403210	ME4628	E7492	504765 594767
3606	3A	GW-003	12/13/84 12/13/84	12/13/84 12/13/84	Chemtech Compu/Chem	431403206 431403184	ME4625	E7489	504765 504760
3606	5A	GW-005	12/12/84 12/12/84	12/13/84 12/12/84	Chemtech Compu/Chem	431403206 431403232	ME4622	E7486	504765 504768
3606	5A	GW-005A	12/12/84 12/12/84	12/13/84 12/12/84	Chemtech Compu/Chem	431403206 431403252	ME4630	E7494	504765 504763
3606	6A	GW-006	12/13/84 12/13/84	12/13/84 12/13/84	Chemtech Compu/Chem	431403206 431403210	ME4627	E7491	504765 504762
3606	7A	GW-007	12/13/84 12/13/84	12/13/84 12/13/84	Computech Compu/Chem	431403206 431403184	ME4626	E7490	504765 504760
3606	8A	GW-008A	12/13/84 12/13/84	12/13/84 12/13/84	Computech Compu/Chem	431403206 431403221	ME4631	E7495	504765 504763
3606	9A	GW-009A	12/13/84	12/13/84	Compu/Chem	431403221		E7487	504761
3606	10A	GW-010	12/12/84 12/12/84	12/13/84 12/12/85	Chemtech Compu/Chem	431403206 431403184	ME4624	E7488	504765 504760
3606	11A	GW-011	12/13/84	12/13/84	Compu/Chem	431403221		E7485	504761
3606	Blank	GW-0099	12/13/84 12/13/84	12/13/84 12/13/84	Computech Compu/Chem	431403206 431403221	ME4632	E7496	504765 504763

*Chemtech - Chemtec Consulting Group, Ltd.
**Compu/Chem Laboratories
GLT360/46

Task 1 and 2 inorganics and Task 3 cyanide analyses were shipped to JTC Environmental Consultants, Inc., in Rockville, Maryland. Phase I samples for organic analyses were shipped to Mead Compu/Chem in Research Triangle Park, North Carolina.

In the second phase sampling effort, samples for Task 1 and 2 inorganics and Task 3 cyanide analyses were shipped to U.S. Testing in Hoboken, New Jersey. Phase II samples for organic analyses were shipped to Environmental Testing and Certification Corporation (ETC) in Edison, New Jersey.

Phase III samples for organic analyses were shipped to Compu/Chem Laboratories (formerly Mead) in Research Triangle Park, North Carolina. Samples for Task 1 and 2, inorganics, and Task 3, cyanide analyses, were shipped to Chemtech Consulting Group, Ltd., in New York, New York.

A summary of the chain-of-custody documentation for samples collected in the Phase I, II, and III sampling efforts appear in Tables 4, 5, and 6. The assigned case numbers were 1838, 2197, and 3606, respectively.

Analytical Results

Inorganic analytical results for groundwater samples are presented in Tables 7, 8, and 9. Organic analytical results are presented in Tables 10, 11, and 12. For organic constituents, only those CLP hazardous substance list (HSL) compounds that were detected are listed. Table 13 lists all of the organic HSL compounds that samples were analyzed for. For samples collected in Phase I, Table 14 identifies compounds that were tentatively identified using GC/MS techniques.

Inorganic analyses for Case No. 1838 (Phase I) reflects poor matrix spike recovery for several memos as noted. Zinc, boron, and tin appeared as blank contaminants in Case No. 1838. Inorganic analyses for Case No. 2197 (Phase II) may be biased high by 25 to 30 percent for barium and nickel based on ICAP intercheck. Inorganic analyses for sample IA-02 reflects poor analytical QA results for several metals as noted.

Case 3606 (Phase III) inorganic analyses results for selenium and antimony are biased low based on low spike recoveries. Tin had a sample spike recovery of only

Table 7
GROUNDWATER INORGANIC ANALYTICAL RESULTS - PHASE I
RCC SITE (SUBTASK 3-2)
CASE NO. 1838

Compound[a]	MS0283 1A-001	MS027 1C-001	MS0284 2A-001	MS0271 2B-001	MS0272 2C-001	MS0285 3A-001	MS0288 3A-002	MS0273 3C-001	MS0274 4C-001	MS0275 4C-002	MS0286 5A-001	MS0276 BD-001
Aluminum[b]	ND	ND	ND	ND	ND	830	320	ND	ND	ND	1,720	ND
Chromium[b]	ND	ND	ND	ND	ND	13	ND	Nd	ND	ND	11	ND
Barium	306	660	330	150	380	570	560	210	510	510	390	ND
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron	2,390	600	2,740	920	670	8,300	6,330	1,820	850	970	7,410	ND
Nickel	ND	ND	ND	ND	ND	42	77	ND	42	52	ND	ND
Manganese	110	22	56	54	17	260	230	51	ND	22	161	ND
Zinc[c]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Boron[c]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	ND	ND	ND	ND	ND	19	20	ND	ND	ND	ND	ND
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	4	ND
Selenium	ND	ND	ND	ND	ND	3	4	ND	ND	ND	ND	ND
Thallium[b]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.4	0.4
Mercury	0.4[d]	ND	0.3[d]	0.3[d]	ND	0.3[d]	ND	ND	ND	ND	ND	11.2[c]
Tin[b,c]	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Lead	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cyanide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

[a]All concentrations expressed in ug/L.
[b]QA data indicate poor or marginal recovery of these spiked metals.
[c]QA data indicate the presence of these metal contaminants in the laboratory method blank.
[d]This metal was also detected in the analysis of the field blank.
ND = Not detected.

GLT360/8

Table 8
GROUNDWATER INORGANIC ANALYTICAL RESULTS - PHASE II
ECC SITE (SUBTASK 3-2)
Case No. 2197

Compound[a]	MS0927 1A-01	MS0298 1A-02	MS0929 1C-01	MS0930 2A-01	MS0921 2B-01	MS0932 2C-01	MS0933 3A-01	MS0934 3C-01	MS0935 4C-01	MS0936 5A-01	MS0937 6A-01	MS0938 7A-01	MS0939 7A-02	MS0940 99-01
Aluminum	<200	406	<200	<200	<200	<200	<200	<200	<200	361	<200	61,500	663	<200
Chromium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	144	ND	ND
Barium[b]	366	357	657	268	188	470	1,070	264	563	392	508	875	397	<100
Beryllium	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Cobalt	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	80	<50	<50
Copper	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	106	<50	<50
Iron	3,070	3,300	736	3,360	1,140	874	10,400	1,720	108	328	5,470	105,000	1,030	210
Nickel[b]	<40	<40	<40	<40	<40	<40	80	<40	<40	<40	<40	176	<40	<40
Manganese	<103	95	28	49	54	23	97	39	23	52	231	1,930	113	<10
Zinc	45	14[c]	19	11	ND	26	19	ND	74	36	35	276	31	49
Boron	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Vanadium	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200	<200
Silver	25	14[c]	<10	<10	27	33	<10	25	19	<10	<10	<10	<10	20
Arsenic	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Antimony	<20	<20[d]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Selenium	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Thallium	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
Mercury	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.8
Tin	<20	<20[d]	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20	<20
Cadmium	<1	<1[d]	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Lead	<5	<5[d]	<5	<5	<5	<5	<5	<5	<5	<5	<5	102	<5	<5
Cyanide	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10

[a]All concentrations expressed in ug/l.
NA = Not analyzed for.
ND = Not detected.
[b]QA data indicate that these metals may be high by 25 to 30% based on ICAP intercheck.
[c]QA data indicate that relative percent differences (RPD's) are outside accepted QA limits for these metals.
[d]QA data indicate that matrix spike recoveries for these analyses are below accepted QA limits.

GLT360/9

Table 9
GROUNDWATER INORGANIC RESULTS - PHASE III
ECC SITE (SUBTASK 3-2)
Case No. 3606

Compound[a]	ME4629 1A-001	ME4628 2A-001	ME4625 3A-001	ME4622 5A-001	ME4630 5A-002	ME4627 6A-001	ME4626 7A-001	ME4631 8A-001	ME4632 BLANK	ME4624 10A-001
Aluminum	304	[65]	[128]	ND	[140]	[66]	[77]	[144]	[57]	[72]
Antimony	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Arsenic	ND	ND	15	ND	ND	ND	ND	ND	ND	ND
Barium	328	287	868	413	438	612	331	353	ND	298
Beryllium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Cadmium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Calcium	95770 E	98200 E	70240 E	94890	99410 E	161100 E	73550 E	98500 E	[900] E	77000 E
Chromium	11	11	15	13	12	ND	ND	ND	ND	ND
Cobalt	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Copper	ND	ND	[16]	ND	ND	ND	ND	ND	ND	ND
Iron	1454	2931	297	202	356	1194	[73]	2545	[98]	[51]
Lead	6.7	ND	ND	ND	ND	ND	6.5	ND	ND	ND
Cyanide	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Magnesium	34660 E	32070 E	131800 E	33140 E	34160 E	69730 E	29780 E	38890 E	[334] E	31440 E
Manganese	66	49	70	73	50	94	57	24	ND	40
Mercury	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Nickel	ND	65	84	[32]	ND	46	ND	ND	[34]	ND
Potassium	ND	ND	105940	ND	ND	[2129]	[2625]	[1195]	ND	[4765]
Selenium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Silver	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Sodium	10060	15490	380700	10980	11210	118000	22300	15130	1424	25520
Thallium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Tin	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Vanadium	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Zinc	69	260	250	155	158	42	37	69	31	54

FOOTNOTES:

E - Value is estimated or not reported due to the presence of interference.
R - Soike sample recovery is not within control limits.
* - Duplicate analysis is not within control limits.
+ - Correlation coefficient for method of standard addition is less than 0.995.
[] - Positive values less than the contract required detection limit.
ND - Not detected

GLT360/58

Table 4
GROUNDWATER SAMPLE IDENTIFICATION MATRIX - PHASE 1
ECC SITE (SUBTASK 3-2)

Sample Number	Date Sampled	Date Shipped	Lab Service	Airbill Number	ITR	OTR	Chain of Custody
ECC-GW-1A-001	7/19/83	7/19/83	JTC	322-856-612	MS0283		5-8908
			Mead Compu/Chem	322-856-601		S2383	5-8910
ECC-GW-1C-001	7/18/83	7/18/83	JTC	322-856-730	MS0270		5-8901
			Mead Compu/Chem	322-856-715		S2370	5-8904
ECC-GW-2A-001	7/19/83	7/19/83	JTC	322-856-612	MS0284		5-8908
			Mead Compu/Chem	322-856-601		S2384	5-8910
ECC-GW-2B-001	7/19/83	7/19/83	JTC	322-856-601	MS0271		5-8908
			Mead Compu/Chem	322-856-012		S2371	5-8910
ECC-GW-2C-001	7/18/83	7/18/83	JTC	322-856-730	MS0272		5-8901
			Mead Compu/Chem	322-856-715		S2372	5-8904
ECC-GW-3A-001	7/19/83	7/19/83	JTC	322-856-612	MS0285		5-8908
			Mead Compu/Chem	322-856-601		S2385	5-8911
ECC-GW-3A-002	7/19/83	7/19/83	JTC	322-856-612	MS0288		5-8909
			Mead Compu/Chem	322-856-601		S2388	5-8912
ECC-GW-3C-001	7/18/83	7/18/83	JTC	322-856-730	MS0273		5-8901
			Mead Compu/Chem	322-856-715		S2373	5-8905
ECC-GW-4C-001	7/18/83	7/18/83	JTC	322-856-730	MS0274		5-8901
			Mead Compu/Chem	322-856-715		S2374	5-8905
ECC-GW-4C-002	7/18/83	7/18/83	JTC	322-856-730	MS0275		5-8902
			Mead Compu/Chem	322-856-715		S2375	5-8905
ECC-GW-5A-001	7/19/83	7/19/83	JTC	322-856-612	MS0286		5-8909
			Mead Compu/Chem	322-856-601		S2386	5-8911
ECC-GW-BK-001	7/19/83	7/19/83	JTC	322-856-612	MS0276		5-8909
			Mead Compu/Chem	322-856-601		S2376	5-8906

OTR = Organic Traffic Report
ITR = Inorganic Traffic Report

GLT360/6

Table 5
GROUNDWATER SAMPLE IDENTIFICATION MATRIX - PHASE II
ECC SITE (SUBTASK 3-2)

Sample Number	Date Sampled	Date Shipped	Lab Service	Airbill Number	ITR	OTR	Chain of Custody
ECC-GW-1A-01	11/29/83	11/29/83	U.S. Testing	235-570-370	MS0927		5-10439
			ETC	235-570-580		S2803	5-8950
ECC-GW-1A-02	11/29/83	11/29/83	U.S. Testing	235-570-370	MS0928		5-10439
			ETC	235-570-580		S2801	5-8950
ECC-GW-1C-01	11/29/83	11/29/83	U.S. Testing	235-570-370	MS0929		5-10439
			ETC	235-570-580		S2802	5-8950
ECC-GW-2A-01	11/29/83	11/29/83	U.S. Testing	235-570-370	MS0930		5-10439
			ETC	235-570-591		S2804	5-8944
ECC-GW-2B-01	11/29/83	11/29/83	U.S. Testing	235-570-370	MS0931		5-10439
			ETC	235-570-591		S2805	5-8944
ECC-GW-2C-01	11/29/83	11/29/83	U.S. Testing	235-570-370	MS0932		5-10439
			ETC	235-570-591		S2806	5-8944
ECC-GW-3A-01	11/29/83	11/29/83	U.S. Testing	235-570-370	MS0933		5-10439
			ETC	235-570-591		S2807	5-8944
ECC-GW-3C-01	11/30/83	11/30/83	U.S. Testing	235-570-414	MS0934		5-8941
			ETC	322-856-715		S2808	5-10440
ECC-GW-4C-01	11/30/83	11/30/83	U.S. Testing	235-570-414	MS0935		5-8941
			ETC	235-570-381		S2809	5-10440
ECC-GW-5A-01	11/30/83	11/30/83	U.S. Testing	235-570-414	MS0936		5-8941
			ETC	235-570-381		S2810	5-10440
ECC-GW-6A-01	11/30/83	11/30/83	U.S. Testing	235-570-414	MS0937		5-8941
			ETC	235-570-381		S2811	5-10441
ECC-GW-7A-01	11/30/83	11/30/83	U.S. Testing	235-570-414	MS0938		5-8941
			ETC	235-570-392		S2812	5-10441
ECC-GW-7A-02	11/30/83	11/30/83	U.S. Testing	235-570-414	MS0939		5-8941
			ETC	235-570-392		S2813	5-10441
ECC-GW-99-01	11/30/83	11/30/83	U.S. Testing	235-570-414	MS0940		5-8941
			ETC	235-570-392		S2814	5-10441

OTR = Organic Traffic Report
ITR = Inorganic Traffic Report

GLT360/7

Comments: Samples were collected in level "D" safety attire. No HNU readings (10.2eV lamp) above background were detected.

November 30, 1983, Wednesday

Collection of groundwater samples was completed on Wednesday. Weather conditions included overcast skies, strong winds, and a temperature of about 27°F.

Groundwater Sampling Team: Same as Tuesday.

Groundwater Samples Obtained:

Well Number	Sample Number
ECC-3C	ECC-GW-3C-001
ECC-4C	ECC-GW-4C-001
ECC-5A	ECC-GW-5A-001
ECC-6A	ECC-GW-6A-001
ECC-7A	ECC-GW-7A-001
	ECC-GW-7A-002
Blank	ECC-GW-99-001

Comments: Groundwater samples were collected in level "D" safety attire. No HNU readings (10.2eV lamp) above background were detected.

November 31, 1983, Thursday

Sampling personnel returned to their home offices.

PHASE III

December 11, 1984, Tuesday

Mark Lepkowski, Randy Weltzin, Megan Morrison, and Jeff Keiser drove to Indianapolis, Indiana with a van containing equipment and supplies.

December 12, 1984, Wednesday

Morrison and Lepkowski began collecting samples, while Weltzin and Keiser took water depths for wells to be sampled. Weather conditions included a high temperature of 48°F with 5 mph winds from the southwest and drizzle or rain in the afternoon.

Groundwater samples obtained:

Well Number	Sample Number
ECC-5A	GW-005
ECC-5A	GW-005A
ECC-10A	GW-010

Comments: All wells were sampled in level "D" safety attire. No HNu readings were taken because of equipment difficulties. Only the organic samples were shipped to the laboratory. Inorganic samples were filtered, preserved, and kept on ice.

December 13, 1984, Thursday

Groundwater sampling was completed on Thursday. Keiser and Weltzin surveyed elevations of casings at wells 6A, 7A, 8A, 9A, 10A, and 11A. Water depths were taken for wells 1C, 2B, 2C, 4C, and 3C. Weather conditions included a high of 42°F, 5 to 10 mph winds, and rain after 11:30 a.m.

Groundwater samples obtained:

Well Number	Sample Number
ECC- 1A	GW-001
ECC- 2A	GW-002
ECC- 3A	GW-003
ECC- 6A	GW-006
ECC- 7A	GW-007
ECC- 8A	GW-008A
ECC- 9A	GW-009A
ECC-11A	GW-011
Blank	GW-0099

Comments: All wells except ECC-8A were sampled in level "D" safety attire. Because the HNu was not operating, level "C" attire was used to sample ECC-8A. All samples, including the inorganic samples from ECC-5A and ECC-10A, were shipped to the contract laboratories.

Sample Documentation

Samples were packed according to EPA Contract Laboratory Program (CLP) protocol. Samples were shipped via Federal Express to the assigned contract laboratory on the day of sampling. In the first phase sampling effort, samples for

The spent decontamination solutions were combined with the purge water in 55-gallon drums and disposed of onsite.

Sampling Chronology

The following chronology summarizes the major activities and events for each day of the groundwater sampling work at the ECC site.

PHASE I

July 17, 1983, Sunday

Ike Johnson, Jerry Bills, Tom Gilgenbach and Dennis Totzke drove to Indianapolis, Indiana, with a van and trailer load of equipment and supplies. A review meeting was held in the evening to review the planned activities for the next day.

July 18, 1983, Monday

Collection of groundwater samples began on Monday. Weather conditions included sunny skies, light winds and temperatures in the mid-80's.

Groundwater Sampling Team: Dennis Totzke, Ike Johnson, and Tom Gilgenbach.

Groundwater Samples Obtained:

Well Number	Sample Number
ECC-1C	ECC-GW-1C-001
ECC-2C	ECC-GW-2C-001
ECC-3C	ECC-GW-3C-001
ECC-4C	ECC-GW-4C-001
	ECC-GW-4C-002

Comments: All wells were sampled in level "D" safety attire. No HNU readings (10.2eV lamp) above background were detected.

July 19, 1983, Tuesday

The collection of groundwater samples was completed on Tuesday. Weather conditions were sunny with light winds and the temperature in the mid-80's.

Groundwater Sampling Team: Same as Monday.

Groundwater Samples Obtained:

Well Number	Sample Number
ECC-1A	ECC-GW-1A-001
ECC-2A	ECC-GW-2A-001
ECC-2B	ECC-GW-2B-001
ECC-3A	ECC-GW-3A-001
	ECC-GW-3A-002
ECC-5A	ECC-GW-5A-001
Blank	ECC-GW-BK-001

Comments: Monitoring well ECC-4A was not sampled because oil contamination was present at the water surface from the well installation. All well sampling was performed in level "D" safety attire. No HNU readings (10.2eV lamp) above background were detected.

PHASE II

<u>November 28, 1983, Monday</u>

Phil Smith and Mike Schuetz of CH2M HILL drove the EPA van to Indianapolis, Indiana.

<u>November 29, 1983, Tuesday</u>

Collection of groundwater samples was initiated on Tuesday. Weather conditions included overcast skies, strong winds, and temperatures around 30°F.

Groundwater Sampling Team: Phil Smith and Mike Schuetz of CH2M HILL and Charles Brunett and Robert Teerman of KMA.

Groundwater Samples Obtained:

Well Number	Sample Number
ECC-1A	ECC-GW-1A-001
	ECC-GW-1A-002
ECC-1C	ECC-GW-1C-001
ECC-2A	ECC-GW-2A-001
ECC-2B	ECC-GW-2B-001
ECC-2C	ECC-GW-2C-001
ECC-3A	ECC-GW-3A-001

Table 3
GROUNDWATER SAMPLING FIELD MEASUREMENTS - PHASE III
ECC SITE (SUBTASK 3-2)

	Well Number	Temperature (°C)	Conductivity (umhos/cm²)	pH
S-CONFINED ?	1A	11	390	6.8
S-CONFINED	2A	9	370	7.2
TILL	3A	12	2,500	6.9
S-CONFINED	5A	12.5	420	-
S-CONFINED	6A	10	1,050	-
S-CONFINED	7A	9	320	7.2
S-CONFINED	8A	10	380	7.3
	10A	13	380	7.5

GLT360/47

S-CONFINED - SHALLOW SAND WATER BEARING ZONE
DEPTH ≈ 10-20' BGS

Distilled water for field blanks was obtained from the ISBH in Indianapolis. Water for the field blanks was poured directly into the sample containers.

Decontamination

Decontamination procedures included steps to avoid contamination of the sample and well and to minimize carryover of contaminants from one well to another. In summary, the steps used to minimize contamination were as follows:

- Sample from the least to most contaminated wells based on previous groundwater data or proximity to the site.
- Decontaminate the outside of all equipment used in the wells including surface water level indicator line, bailer, sampling pump and discharge line after each well sampling.
- Decontaminate the inside of the bailer after each use.
- Decontaminate the inside of the submersible pump by pumping decontamination solutions in sequence through the pump after each well sampling.
- Purge each monitoring well before sampling. This not only removes stagnant water from the well but also any contamination or decontamination solution that may be present in the sampling equipment.

Three solutions were used in sequence to decontaminate well sampling equipment. These solutions were TSP and distilled water, acetone and distilled water (approximately 20 percent acetone V/V), and a distilled water rinse. To decontaminate the inside of the sampling pump and line, each solution was pumped for 60 seconds through the pump and discharge line. Decontamination solutions were changed daily and then disposed of. The bailer was decontaminated by dipping it several times into each of the solutions in the order specified above.

The decontamination procedure for gloves used to handle equipment was washing in TSP solution followed by an acetone solution wash and a distilled water rinse.

Table 2
GROUNDWATER SAMPLING FIELD MEASUREMENTS - PHASE II
ECC SITE (SUBTASK 3-2)

Well Number	Temperature (°C)	Conductivity (umhos/cm²)	pH
1A	8	275	8.3
1C	7	390	6.9
2A	8	240	9.0
2B	8	380	6.9
2C	8	400	6.9
3A	9	2,400	6.9
3C	8	430	6.9
4C	8	390	6.8
5A	8	460	6.7
6A	8	910	6.6
7A	8	410	6.9

GLT360/14

Table 3 (Page 2 of 3)

Boring No.	Sample No.	Depth (Inches Below Grade)	Visual Classification (USCS)	Field OVA Reading (ppm Above Background)	Field Laboratory Total Volatile Organic Screen (ppm)	Comments
A-2	S-1	0-6	Silty clay fill, light brown, moist.	0	7	
	S-2	6-12		0	3	
	S-3	12-18		0	6	
	S-4	18-22		--	--	
A-5	S-1	0-6	Silty clay fill, light brown.	0	6	
	S-2	6-12		1 to 1.5	11	
	S-3	12-18		1 to 1.5	5	
	S-4	18-20		1 to 1.5	21	
A-8	S-1	0-6	Silty clay fill, brown to gray, moist.	2 to 3	35	
	S-2	6-18		4	25	
	S-3	18-24		4	26	
A-10	S-1	0-9	Silty clay fill, brown, moist.	15	270	
	S-2	9-18		64	60	
	S-3	18-24		60	1	

Table 3 (Page 3 of 3)

Boring No.	Sample No.	Depth (Inches Below Grade)	Visual Classification (USCS)	Field OVA Reading (ppm Above Background)	Field Laboratory Total Volatile Organic Screen (ppm)	Comments
AE-AG	S-1	0-6	Waste material, gray, crushed limestone fragments, wet.	6	15	
	S-2	6-12	Crushed limestone fragments, gray oil seeping into borehole.	100	160	Boring stopped due to wet conditions
AE-AH	S-1	0-6	Miscellaneous fill, dark gray, wet.	30	1,060	
	S-2	6-12		50	600	
AM	S-1	0-6	Silty clay fill, stained black, assorted waste material, moist.	0	1	
	S-2	6-12	Silty clay fill, brown, moist.	0	1	
	S-3	12-18		0	1	
	S-4	18-24		0	1	
AN	S-1	0-6	Silty clay fill, brown, moist.	1 to 3	8	
	S-2	6-12		30	8	
	S-3	12-20		40	1	
	S-4	20-26		40	2.5	
AO	S-1	0-6	Silty clay fill, brown, moist.	1	1	
	S-2	6-12		1	1	
AP	S-1	0-6	Silty clay fill, brown, moist.	3	1	
	S-2	6-12		0	2	

Table 3 (Page 1 of 3)
PHASE 1 - SUMMARY OF SOIL BORINGS
ECC SITE

Boring No.	Sample No.	Depth (Inches Below Grade)	Visual Classification (USCS)	Field OVA Reading (ppm Above Background)	Field Laboratory Total Volatile Organic Screen (ppm)	Comments
D-1	S-1	0-6	Silty clay fill, stained dark gray, wet	--	2,370	Dark gray and black soil samples.
	S-2	6-12	Silty clay fill, stained dark gray, moist to wet, pieces of crushed limestone.	--	1,360	Appear to be stained with oil.
	S-3	12-18	Silty clay fill, stained dark gray, moist to wet, pieces of crushed limestone.	--	300	
	S-4	18-24	Silty clay fill, light brown, moist.	--	2,300	
D-3	--	0-6	Silty clay fill, dark gray, moist, pieces of crushed limestone.	--	--	No sample collected from 0 to 6" due to wet conditions.
	S-1	6-12	Silty clay fill, light brown, moist.	--	1,040	
D-7	--	0-18	Silty clay fill, dark gray to black, crushed limestone fragments, wet.	--	--	No sample collected from 0 to 18" due to wet conditions.
	S-1	18-20	Silty clay fill, dark gray to black, crushed limestone fragments, wet.	--	1,660	
	S-2	20-24	Silty clay fill, light brown, moist.	--	1,320	
D-9	--	0-12	Silty clay-clayey silt fill, dark gray to black, crushed limestone fragments, wood plank at 12".	--	--	Boring stopped at 12" due to wood plank, no sample collected.
B-6	S-1	0-6	Silty clay fill, gray.	100	1,800	Could not advance boring below 6" depth due to rocks.

very wet soil that visually appeared to be stained dark gray to black with oils and solvents. Borings A2, A5, A8, and A10 were advanced into the berm located along the unnamed ditch (Figure 1). Soil samples from these borings did not appear to be stained, and were generally light brown colored. Four additional borings were completed along the berm adjacent to the south concrete storage pad (AM, AN, AO and AP shown in Figure 1). Samples from these borings were light brown colored and did not appear to be stained. A summary of soil boring samples is presented in Table 3. A total of 11 borings were completed in the north drum storage areas instead of the 30 proposed in the sampling plan, due to the wet conditions. Borings D3, D7, B6, and AE-AG were stopped when water filled the boreholes.

SECOND SAMPLING EFFORT

PERSONNEL

The sampling team for the second soil sampling effort consisted of the following personnel from CH2M HILL:

- Dennis Totzke - Project Manager
- Isaac Johnson - Geotechnical Engineer/Site Safety Coordinator
- Brad Berggren - Geotechnical Engineer/Site Safety Coordinator
- Richard Onderko - OVA Operator
- Ron Schlicher - Sampling Team Member
- Thomas Gilgenbach - Sampling Technician
- Mark Lepkowski - Sampling Technician

SOIL SAMPLING

Soil sampling from borings and test pits occurred from October 22 through November 6, 1984. Weather conditions during this period were variable with temperatures in the 28°F to 60°F range and work was stopped or delayed on some days due to rain.

Soil borings were advanced using a small drill rig and hollow stem augers. Soil samples were collected at 2-foot intervals in each boring using standard split spoons to a depth of about 10 to 12 feet or the water table, whichever was reached first. Each soil sample was logged and

Table 2 (Page 1 of 2)
PHASE 1 - SURFACE SOIL SAMPLING SUMMARY, ECC SITE

Sample No.	Location	Visual Classification	Field OVA Reading (ppm above Background	Field Laboratory Total Volatile Organics Screen (ppm)	Comments
AA	North berm	Silty clay fill, brown, very stiff to hard, moist	0	0	
AB	North berm		0	0	
AC	North berm		0	0	
AD	North berm		0	0	
AE	North berm		0	0	
AF	North berm		0	0	
AG	North berm		0	0	
AH	North berm		0	0	
AI	North berm		0	0	
AJ	North berm		0	0	
AK	North berm		0	0	
AL	North berm		0	0	
C6-C7	North barrel pad	Surface water, red to orange color	0	180	Ponded water sample.
AM-SW	Southwest corner	Fill, Miscellaneous material and soil, black	50	200	Appeared oil stained.
AO-SE	East of concrete pad	Silty clay fill, dark brown, moist.	50	15	

Sample No.	Location	Visual Classification	Field OVA Reading (ppm above Background	Field Laboratory Total Volatile Organics Screen (ppm)	Comments
AP-SE	East of concrete pad	Silty clay fill, dark brown, moist.	10	50	
N of C	Between lagoon and south concrete pad	Silty clay fill, dark gray to black, wet.	50	700	Very wet conditions, soil appeared stained.
Pit C	Polymer pit	Silty clay, light brown, moist.	--	15	
Pit S	Polymer pit	Silty clay, light brown, moist.	--	3	
Pit N	Polymer pit	Silty clay, light brown, moist.	--	5	

GLT360/39-2

This left large ruts, 1 to 2 feet deep, throughout the former drum storage areas. Standing water, generally less that 6 inches deep, was located along the eastern side of the north drum storage area. The soil generally appeared discolored or stained dark gray to black throughout the former drum storage areas.

Several problems were caused by the unexpected wet surface conditions. The soft, wet soil made walking difficult for the sampling team members. High OVA or HNU readings were noted while monitoring air quality in areas disturbed by Chem-Waste's bulldozer activity. The major problem associated with sampling was that many of the borings would fill with liquid; therefore, deeper soil samples would be contaminated by the liquid. Due to the site conditions encountered, representative samples could not be collected with depth in borings located in wet areas. The sampling team decided not to complete the total 90 borings proposed in the sampling plan for this trip. Additional soil sampling will be conducted after Chem-Waste has completed the site cleanup and site conditions become more favorable for sampling.

FIELD RESULTS

Two types of soil samples were collected at the ECC site, surficial samples and boring samples. Eleven borings were advanced in the north drum storage area (Figure 1) to assess the depth and concentration of volatile organic contaminants. Four borings were also advanced on the perimeter of the concrete pad which served as the south drum storage area (Figure 1). Surficial soil samples were collected at the locations shown in Figure 1 and summarized in Table 2. Twelve samples (AA through AL) were collected along the large embankment along the north and northwest sides of the site to determine whether this material may be suitable for use as cover for future remedial actions. Three samples were collected in the polymer pit area (Pit N, Pit DC and Pit S) to assess cleanup activities performed by Chemical Waste Management, Inc. Three samples (AM-SW, AO-SE and AP-SE) were also collected adjacent to the south concrete storage pad. One surface composite sample (N of C) was collected in the drum storage area between the concrete pad and the lagoon (Figure 1).

Of the 11 borings completed in the north drum storage areas, 7 (B6, D1, D3, D7, D9, AE-AG and AE-AH) were advanced through

FIELD LABORATORY SCREENING

A field laboratory was set up in the EPA office trailer to qualitatively determine whether volatiles were present in the soil samples. Soil samples were collected in 40-ml VOA containers with approximately 25 percent headspace. At the field laboratory, each sample was warmed in a water bath to a temperature of 90°F. The sample was then shaken vigorously for about 20 seconds to drive volatiles from the sample into the air headspace. A gas-tight syringe was used to withdraw vapor from the headspace of the sample container. The amount of vapor withdrawn was dependent upon the expected concentration of contaminants. A 1.0-ml volume was used for low concentration or relatively clean samples. A 250-ml volume was used for samples that were contaminated with volatile organics, based on or OVA field screening. The vapor extracted from the headspace was then injected into the GC column injection port of a Foxboro Organic Vapor Analyzer (OVA), model number 180. The sample was injected relatively slowly to avoid blowing out the flame in the detector. Generally, peaks of several individual compounds were noted during the first one to two seconds. A short time later, a backflush peak was then noted. To determine the total concentration of volatile organics in the sample the corresponding values for the various peaks were added. Depending on the response of the initial injection, a second injection was sometimes made for confirmation. A strip chart recorder was used to document the response for each injection.

SITE CONDITIONS

The site conditions during the week of May 7, 1984, were generally not favorable for soil sampling. Heavy rains the 2 weeks before resulted in wet, muddy conditions. Also, Chemical Waste Management, Inc. (Chem-Waste) was in the process of removing the last drums from the site. Drums had been completely removed from the northern half of the site. All drums had also been removed from the soil pad located between the pond and the concrete storage pad (Figure 1). A few drums were still stored on the concrete pad located on the southern half of the site. In addition to removing the drums, Chem-Waste had excavated waste material and highly contaminated soil from the polymer pit area shown in Figure 1.

The surface soil conditions at the former drum storage areas, both north and south of the pond, were generally wet and very soft to depths up to 2 feet. Chem-Waste was running a bulldozer through the wet soil in an attempt to dry it.

Table 4
SAMPLE IDENTIFICATION MATRIX FOR SOIL SAMPLES
COLLECTED OCTOBER 1984 FROM SOIL BORINGS

Boring Number	Sample Number	Case Number	Date Sampled	Date Shipped	Laboratory	Airbill Number	OTR	ITR	Chain of Custody
SB-01	SB0102	3405	10-24-84	10-25-84	IT Corporation	855654100	E4912		504497
			10-24-84	11-08-84	Rocky Mountain Analytical Labs	855654096		ME4186	504506
	SB0104	3405	10-22-84	10-25-84	IT Corporation	855654100	E4913		504497
			10-22-84	11-08-84	Rocky Mountain Analytical Labs	855654096		MEA309	504506
SB-02	SB0202	3405	10-22-84	10-25-84	IT Corporation	855654100	E4914		504497
			10-22-84	11-08-84	Rocky Mountain Analytical Labs	855654096		MEA310	504506
	SB0204	3405	10-22-84	10-25-84	IT Corporation	855654100	E4915		504497
			10-22-84	11-08-84	Rocky Mountain Analytical Labs	855654096		MEA311	504506
SB-03	SB0302A	3405	10-24-84	10-25-84	IT Corporation	855654100	E4928		504499
	SB0302B	3405	10-24-84	10-25-84	IT Corporation	855654100	E4929		504499
SB-04	SB0401	3405	10-24-84	11-08-84	Compu/Chem	855654111	E4934		504502
					Rocky Mountain Analytical Labs	855390196		MEA320	504506
	SB0403	3405	10-24-84	11-08-84	Compu/Chem	855654111	E4933		504502
			10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA319	504506
SB-05	SB0502	3405	10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA325	504504
	SB0502	3405	10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA324	504504
	SB0505	3405	10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA323	5045014
	SB0505	3405	10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA322	504506
SB-06	SB0601	3405	10-23-84	11-08-84	Compu/Chem	855654111	E4932		504502
			10-23-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA318	504506
SB-08	SB0802	3405	10-24-84	11-08-84	Compu/Chem	855654111	E4931		504502
			10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA317	504506
	SB0805	3405	10-24-84	11-08-84	Compu/Chem	855654111	E4935		504502
			10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA321	504506
SB-09	SB0902	3405	10-24-84	11-08-84	Compu/Chem				
		3405	10-24-84	11-08-84	Rocky Mountain Analytical Labs	855654111	E8077		504502
	SB0904	3405	10-24-84	10-25-84	IT Corporation	855390196		MEA316	504506
		3405	10-24-84	11-08-84	Rocky Mountain Analytical	855654100	E4930		504499
					IT Corporation	855390196		MEA315	504506

classified by a geotechnical engineer and was stored in clean, numbered glass jars with Teflon liners under the caps. Split spoons and sampling rods were washed between each sampling event using a two-rinse procedure consisting of a TSP/sodium bicarbonate solution and distilled water. Excess drill cuttings and all water were stored in a secure area onsite. Hollow stem augers were steam cleaned between borings. Boreholes were grouted with bentonite slurry upon completion of sampling. All boring locations were plotted on the site topographic map.

Organic samples from the soil borings were shipped to IT Corporation in Cerritos, California, or Compu/Chem Laboratories in Research Triangle Park, North Carolina, for analyses (Table 4). Samples for inorganic analyses were shipped to Rocky Mountain Analytical Laboratory in Arvida, Colorado.

Test pits were advanced using a backhoe to a depth of about 8 to 10 feet. The pits were photographed and logged by a geotechnical engineer. Soil samples were collected with hand augers at approximately 2-foot depth intervals in each pit. Sampling equipment and jars were washed in the same manner as for the soil borings. The backhoe shovel was steam cleaned between pits. Soil removed from the pits was lowered back into the pits to approximately the same depths from which it was removed. Test pit locations were plotted on the site topographic map.

Samples of soil from the test pits were shipped to IT Corporation for analyses (Table 5). Inorganic samples were shipped to Rocky Mountain Analytical Laboratory.

LABORATORY SCREENING

As part of the sampling procedure, all samples were screened offsite using headspace analysis techniques with an OVA as described previously.

SITE CONDITIONS

Site cleanup activities were to have been completed before the sampling team reached the site; however, bulk storage tanks were being decontaminated and soil and storage tanks were still being removed from the site. Heavy equipment and storage tanks prevented access to TP Areas 3 and 8.

Table 5 (Page 1 of 2)
PHASE 2 - SAMPLE IDENTIFICATION MATRIX FOR SOIL SAMPLES
COLLECTED OCTOBER AND NOVEMBER 1984 FROM TEST PITS

Sample Number	Case Number	Date Sampled	Date Shipped	Laboratory	Airbill Number	OTR	ITR	Chain of Custody
TP-1 Shallow	3405	10-22-84	10-25-84	IT Corporation	855654100	E4901		504496
				Rocky Mountain Analytical Labs	855654096		ME4162	504500
TP-2 Shallow	3405	10-22-84	10-25-84	IT Corporation	855654100	E4903		504496
				Rocky Mountain Analytical Labs	855654096		ME4164	504500
TP-3 Shallow	3405	10-22-84	10-25-84	IT Corporation	855654100	E4904		504496
				Rocky Mountain Analytical Labs	855654096		ME4165	504500
TP-4 Shallow	3405	10-22-84	10-25-84	IT Corporation	855654100	E4905		504496
				Rocky Mountain Analytical Labs	855654096		ME4166	504500
TP-4 Mid	3405	10-22-84	10-25-84	IT Corporation	855654100	E4906		504496
				Rocky Mountain Analytical Labs	855654096		ME4167	504500
TP-5 Shallow	3405	10-22-84	10-25-84	IT Corporation	855654100	E4907		504496
				Rocky Mountain Analytical Labs	855654096		ME4168	504500
TP-5S Shallow	3405	10-22-84	10-25-84	IT Corporation	855654100	E4907		504497
TP-5 Mid	3405	10-22-84	10-25-84	IT Corporation	855654100	E4908		504496
				Rocky Mountain Analytical Labs	855654096		ME4169	504500
TP-6 Shallow	3405	10-22-84	10-25-84	IT Corporation	855654100	E4909		504497
				Rocky Mountain Analytical Labs	855654096		ME4170	504500
TP-6 Mid	3405	10-22-84	10-25-84	IT Corporation	855654100	E4910		504497
				Rocky Mountain Analytical Labs	855654096		ME4171	504500
TP-6 Deep	3405	10-22-84	10-25-84	IT Corporation	855654100	E4911		504497
				Rocky Mountain Analytical Labs	855654096		ME4172	504500
TP-7 Shallow	3405	10-23-84	10-25-84	IT Corporation	855654100	E4917		504498
				Rocky Mountain Analytical Labs	855654096		ME4177	504500

Sample Number	Case Number	Date Sampled	Date Shipped	Laboratory	Airbill Number	OTR	ITR	Chain of Custody
TP-7 Mid	3405	10-23-84	10-25-84	IT Corporation	855654100	E4916		504498
				Rocky Mountain Analytical Labs	855654096		ME4178	504500
TP-8 Shallow	3405	10-24-84	10-25-84	IT Corporation	855654100	E4918		504498
				Rocky Mountain Analytical Labs	855654096		ME4179	504500
TP-8 Mid	3405	10-24-84	10-25-84	IT Corporation	855654100	E4919		504498
				Rocky Mountain Analytical Labs	855654096		ME4180	504500
TP-9 Shallow	3405	10-24-84	10-25-84	IT Corporation	855654100	E4920		504498
				Rocky Mountain Analytical Labs	855654096		ME4181	504501
TP-9 Mid	3405	10-24-84	10-25-84	IT Corporation	855654100	E4921		504498
				Rocky Mountain Analytical Labs	855654096		ME4182	504501
TP-10 Shallow	3405	10-24-84	10-25-84	IT Corporation	855654100	E4922		504498
				Rocky Mountain Analytical Labs	855654096		ME4183	504501
TP-10 Mid	3405	10-24-84	10-25-84	IT Corporation	855654100	E4923		504498
		10-24-84	11-08-84	Rocky Mountain Analytical Labs	855654096		MEA312	504506
TP-10S Mid	3405	10-24-84	10-25-84	IT Corporation	855654100	E4923		504499
TP-11 Shallow	3405	10-24-84	10-25-84	IT Corporation	855654100	E4924		504499
				Rocky Mountain Analytical Labs	855654096		ME4184	504501
TP-11 Mid	3405	10-24-84	10-25-84	IT Corporation	855654100	E4925		504499
		10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA313	504506
TP-12 Shallow	3405	10-24-84	10-25-84	IT Corporation	855654100	E4926		504499
				Rocky Mountain Analytical labs	855654096		ME4185	504501
TP-12 Mid	3405	10-24-84	11-08-84	Rocky Mountain Analytical Labs	855390196		MEA314	504506
		10-24-84	10-25-84	IT Corporation	855654100	E4927		504499

GLT360/48-2

Rain for several days prior to soil sampling and on some days during soil sampling resulted in standing water in some areas and up to 2 feet of mud over the remainder of the site. Soil borings planned for T.B. Area 1 were cancelled because the soil could not support a drill rig. Test pits planned for TP Areas 1 and 2 (refer to Figure 2) were deleted or moved due to soft soil conditions. TP-6 was moved west because of standing water in the planned location.

FIELD RESULTS

Nine soil borings were advanced through the south concrete pad to a maximum depth of 12.5 feet in order to assess the vertical extent of contamination in this area. The locations of these borings can be seen in Figure 2. Boring logs are included in Appendix A. A description of the material encountered in the borings and the samples taken from the borings is presented in Table 6. Field HNu readings and laboratory OVA results are also presented in Table 6.

Twelve test pits were excavated in the locations indicated in Figure 2. A summary of the samples collected from the test pits and a description of the material encountered in the sampled horizons is included in Table 7 along with laboratory OVA results. Logs of the test pits are included in Appendix A.

ANALYTICAL RESULTS

No inorganic analyses were run on the samples collected in May for this subtask. Organic analytical results for priority pollutant hazardous substance list (HSL) constituents are presented in Table 8 for Phase 1. Only those HSL compounds that were detected in these samples are listed in these tables. Table 9 lists all the organic HSL compounds that the samples were analyzed for.

Based on Average Surrogate Percent Recover (ASPR) and the Coefficient of variation (Cv), volatile and base/neutral results are quantitative with one exception. Sample E7247; the result for N-nitrosodiphenylamine is qualitative. Based on low ASPR and high Cv, the acid sample analysis are qualitative. Pesticide/PCB results are semi-quatitative based on ASPR of 71 percent and Cv of 46 percent. Dioxin results are qualitative, the ASPR is good at 105 percent but Cv is very high at 68 percent.

Table 6 (Page 1 of 3)
PHASE 2 - SUMMARY OF SOIL BORINGS OCTOBER 1985

Boring Number	Sample Number	Depth Interval Feet Below Ground Surface (ft)	Visual Classification	Field HNU Screening (ppm)	Total Volatile Organics OVA Screening (ppm)	Comments
SB-01	-	0-0.5	Concrete pad	-	-	No sample collected
	01	1.0-2.5	Dark brown gravelly silt to red-brown silty clay	1 to 2	1,200	
	02	2.5-4.0	Red brown silty clay, some gravel	0	270	Sample sent to CLP
	03	4.0-5.5	As above	0	-	
	04	5.5-7.0	As above	0	15	Sample sent to CLP
	05	7.0-8.5	Dark brown silty clay some fine sand and gravel	0	2	
	06	8.5-10.0		0	1	
	07	10.0-11.5		0	2	Bottom of boring at 11.5 feet
SB-02	-	0-0.5	Concrete pad	-	-	
	01	1.0-2.5	Coarse gravel with dark brown sandy silt	15	6,250	
	02	2.5-4.0	Red brown, silty clay, some gravel	6	9,000	Sample sent to CLP
	03	4.0-5.5	Dark brown silty clay, some gravel	0	100	
	04	5.5-7.0	As above	0	7	Sample sent to CLP
	05	7.5-9.0	As above	0	21	
	06	9.0-10.5	As above	0	7	
	07	10.5-12.0	As above	0	5	Bottom of boring at 12.0 feet
SB-03	-	0-0.5	Concrete pad	50	-	
	01	1.0-2.5	Fill - coarse gravel some silty clay	50	12,500	
	02	2.5-4.0	Red brown, gravelly silty clay	15	6,000	Sample and duplicate sent to
	-	4.0-5.5		-	-	CLP. No recovery from split
	03	5.5-7.0		0	2,650	spoon sampler
	04	7.0-8.5	Gray brown, coarse sand to gray brown silty clay	0	9	
	-	8.5-10.0		-	-	No recovery from split spoon sampler.
	05	10.0-11.5	Gray brown silty clay	0	6	Bottom of boring at 11.5 feet.
SB-04	-	0-1.0	Concrete pad	-	-	
	01	2.0-3.5	Top 4" - gray brown gravelly silt Bottom 14" - red brown, gravelly silty clay	15	500	Sample sent to the CLP
	02	3.5-5.0	Red-brown, gravelly silty clay	6	500	

Table 6 (Page 2 of 3)

Boring Number	Sample Number	Depth Interval Feet Below Ground Surface (ft)	Visual Classification	Field HNU Screening (ppm)	Total Volatile Organics OVA Screening (ppm)	Comments
SB-04 (Cont.)	03	5.0-6.5	Red-brown, gravelly silty clay	1	20	Sample sent to the CLP
	04	6.5-8.0	As above	0	25	
	05	8.0-9.5	As above	0	70	
	06	9.5-11.0	As above	0	60	
	07	11.0-12.5	As above	0	70	Bottom of boring at 12.5 feet
SB-05	-	0.0.7	Concrete pad	-	-	
	01	1.5-3.0	Top 3" - Coarse gravel fill Bottom 11 - Red-brown, silty clay	15	1,200	
	02	3.0-4.5	Red-brown, silty clay	30	1,800	Inorganics sample sent to CLP
	03	4.5-6.0	Gray silty clay	15	100	
	04	6.0-7.5	Gray silt	5	17	
	05	7.5-9.0	Top 6" - gray silty sand Bottom 12" - gray clayey silt	4	21	
	06	9.0-10.5	As above	3	9	
	07	10.5-12.0	Dark gray, silty clay	2	29	Bottom of boring at 12.0 feet
SB-06	-	0-1.0	Concrete pad	-	-	
	01	2.0-3.5	Red-brown, silty clay, some fine gravel	200	>5,000	Sample set to CLP
	02	3.5-5.0	Light brown, fine to medium sand	350	3,125	
	03	5.0-6.5	Red-brown, silty clay, some fine gravel	150	3,800	
	04	6.5-8.0	Dark gray-brown, silty clay some fine gravel	50	150	
	05	8.0-10.0	Gray-brown, fine to medium sand, wet	4	300	
	06	10.0-11.5	Dark gray-brown, silty clay	5	5	Bottom of boring at 11.5 feet
SB-07	-	0-0.7	Concrete pad	-	-	
	01	1.0-2.5	Top 4" - coarse gravel fill Bottom 10" - gray-brown, clayey silt	20	800	
	02	2.5-4.0	Gray-brown, clayey silt	20	-	
	03	4.0-5.5	Gray-brown, clayey silt	4	6	
	04	5.5-7.0	Gray clayey silt	4	5	
	05	7.0-8.5	Top 8" - gray silt, moist to wet Bottom 8" - gray silty sand, wet	3	2	
	06	8.5-10.0	Gray silt, moist	2	4	
	07	10.0-11.5	Gray silt to fine sand	2	7	Bottom of boring at 11.5 feet

Table 6 (Page 3 of 3)

Boring Number	Sample Number	Depth Interval Feet Below Ground Surface (ft)	Visual Classification	Field HNU Screening (ppm)	Total Volatile Organics OVA Screening (ppm)	Comments
SB-08	-	0-0.6	Concrete pad	-	-	
	01	1.0-2.5	Black pea gravel and coarse gravel fill	120	10,000	
	02	2.5-4.0	Red-brown, silty clay, some fine gravel	20	1,200	Sample sent to CLP
	03	4.0-5.5	As above	20	500	
	04	5.5-7.0	As above	1	7	
	05	7.0-8.5	Dark gray, silty clay some fine gravel	1	2	
	06	8.5-10.0	As above	0	10	
	07	10.0-11.5	As above	0	2	Bottom of boring at 11.5 feet
SB-09	-	0-0.7	Concrete pad	-	-	
	01	1.0-2.5	Pea gravel and coarse gravel fill	250	13,000	
	02	2.5-4.0	Red-brown, silty clay, some fine gravel	40	8,750	Sample sent to CLP
	03	4.0-5.5	As above	40	3,300	
	04	5.5-7.0	As above	20	2,800	Sample sent to CLP
	05	7.0-8.5	As above	9	4,500	
	06	8.5-10.0	As above	5	58,750	
	07	10.0-11.5	As above	20	13,500	Bottom of boring at 11.5 feet

Notes:

GLT360/45

Table 7 (Page 1 of 3)
PHASE 2 - SUMMARY OF TEST PITS
OCTOBER 1985

Test Pit Number	Sample Number	Depth Feet Below Ground Surface	Visual Classification[1]	Total Volatile Organics OVA Screening (ppm)	Comments
TP-1	0-6"	0-0.5	Dark brown cobble fill with silty clay	290	
	Shallow	1.0-1.5	Reddish brown, sandy, silty clay, some fine to med. gravel, numerous gray varigations and pore channels, massive to subblocky structure (weak), some platy structure nearer surface.	1,400	Sample sent to CLP
	Middle	2.0-3.0	As above.	3.5	
	Deep	4.0-5.0	As above from 4 to 4.5' with med. brown silty clay containing some sand and gravel from 4.5 to 5.0', water at approx. 4.5'.	18.5	Sample sent to CLP
TP-2	0-6"	0-0.5	Coarse gravel fill	12	
	Shallow	1.0-1.5	Reddish brown, silty clay with some sand and gravel, mottled and varigated gray and reddish brown. Coarse sand in the northwest corner of the test pit.	40	Sample sent to CLP
	Medium	2.0-3.0	As above without coarse sand.	2	
	Deep	4.0-5.0	As above.	15	
TP-3	0-6"	0-0.5	Dark gray-brown, coarse gravel fill with a silty clay binder.	400	
	Medium	2.0-2.5	Reddish brown silty clay, deep reddish brown stains on fractures and joints, platy to subblocky structure (strong).	1,000	Sample sent to CLP
	Deep	4.0-4.5	As above except massive to weak subblocky structure with more even gray-brown mottling or varigation.	500	
TP-4	Shallow	1.0-2.0	Medium brown, silty clay with sand and gravel, med. subblocky structure.	3,100	Sample sent to CLP
	Medium	2.5-3.5	As above with gradual transition to reddish brown, silty clay, mottled or varigated gray and reddish brown.	4,200	
	Deep	5.5-6.0	Medium brown silty clay.	2,600	

Table 7 (Page 2 of 3)

Test Pit Number	Sample Number	Depth Feet Below Ground Surface	Visual Classification[1]	Total Volatile Organics OVA Screening (ppm)	Comments
TP-5	0-6"	0-0.5	Black stained surface horizon.	1,100	
	Shallow	1.0-2.0	Medium brown, silty clay with gravel and sand, firm, gradual transition to underlying horizon.		19 Sample sent to CLP
	Medium	2.0-3.0	Reddish brown, varigated gray-brown, silty clay with gravel and sand, firm, gradual transition to underlying horizon.	130	Sample sent to CLP
	Deep	5.0-5.5	Medium to dark brown-gray, silty clay, firm.	190	
TP-6	0-6"	0-0.5	Black stained "goo."	3,500	
	Shallow	1.0-2.0	Medium brown silty clay with gravel and sand, abundant areas of what appears to be straw.	5,000	Sample sent to CLP
	Medium	2.0-3.0	As above in south half of test pit with north half containing gray-brown, firm silty clay with some mottling.	380	Sample sent to CLP
	Deep	4.0-5.0	Medium brown and reddish brown varigated, silty clay with weak subblocky structure and some lenses of sand and gravel.	140	Sample sent to CLP
TP-7	0-6"	0-0.5	Pit filled with water before description was noted.	3,400	
	Shallow	1.0-2.5		360	Sample sent to CLP
	Medium	2.5-4.0		16,500	Sample sent to CLP
TP-8	0-6"	0-0.5	Brown Clay	7,500	
	Shallow	1.0-2.5	Brownish gray clay with scraps of ceramic material.		Sample sent to CLP
	Medium	2.5-4.0	As above with gravel layer from 3 to 4 feet; test pit filled with water below 4.5 feet.		Sample sent to CLP
TP-9	0-6"	0-0.5	Brownish gray silty sand and clay	800	
	Shallow	1.0-3.0	As above with black material from about 1.5 to 2 feet.	2,000	
	Medium	3.0-5.0	Brown clay.	60	
	Deep	5.0-6.0	As above.	30	
TP-10	0-6"	0-0.5	Brownish clay.		
	Shallow	1.0-3.0	As above from 1 to 2.5 feet, asphalt concrete pad from 2.5 to 3.5 feet.		Sample sent to CLP
	Medium	3.0-5.0	Gravel layer from 3.5 to 4 feet; brownish gray clay from 4 to 5.5 feet.		Missing TP-10 OVA screening samples

TABLE 8
SOIL ORGANIC RESULTS (ug/kg)
PHASE I SAMPLING
EDC Site TM 3-4

Sample Location: / Depth (ft): / Date Sampled: / OTR Number:	AA 0-0.5 5-8-84 E-7244	AC 0-0.5 5-8-84 E-7245	AE 0-0.5 5-8-84 E-7246	AG 0-0.5 5-8-84 E-7247	AI 0-0.5 5-8-84 E-7248	AK 0-0.5 5-8-84 E-7249	AL 0-0.5 5-8-84 E-7250	AM-SW 0-0.5 5-9-84 E-7255	AD-SE 0-0.5 5-8-84 E-7251	AP-SE 0-0.5 5-8-84 E-7252	N OF P 5-9-84 E-7253	N OF PD 5-9-84 E-7254	AN 0-0.5 5-9-84 E-7256	AE-AH 0-0.5 5-9-84 E-7257	AE-AG 0-0.5 5-9-84 E-7258	B-6 0-0.5 5-8-84 E-7259	D-7 1.5-2 5-8-84 E-7260
	SURFACE SOIL SAMPLES FROM NORTH AND NORTHWEST EMBANKMENTS							SURFACE SOIL SAMPLES					SOIL BORING SAMPLES				
VOLATILE COMPOUNDS																	
1, 2-DICHLOROETHANE									280								
1, 1, 1-TRICHLOROETHANE								676000	17500	193500	7411400	4510000	40	40000	270000	1203200	635000
1, 1-DICHLOROETHANE										700			60				
CHLOROFORM									500	890			20			41000	17600
TRANS-1, 2-DICHLOROETHENE								34400	79700	1500			100			41000	
CIS-1, 3-DICHLOROPROPENE															12000		
ETHYLBENZENE	80							262000	600		121200	514000		9000	5649000	155000	120000
METHYLENE CHLORIDE	70	10	10	20	20	50	50	515000	2400	2500	141800	120000	10	34000	35000	65500	94000
CHLOROMETHANE																	
TETRACHLOROETHENE								4116000	570	4600	617200	625000		131000	238000	630000	744100
TOLUENE								751000	14000		687100	674000		80000	273000	470700	964000
TRICHLOROETHENE							2 K	4214000	1800	2000	6000200	2006000	60	147000	664000	2135700	1375000
VINYL CHLORIDE									6400								
ACETONE									30300								
2-BUTANONE									5200							99200	89600
4-METHYL-2-PENTANONE									730		2600 K	2200 K				7600	29600
STYRENE														5000	19000		13000
TOTAL XYLENES								1160000	15000		707800	345000		97000	633000	882600	607000
TOTAL VOLATILES	150	10	10	20	20	50	52	11720400	175860	206490	15769300	8796200	290	551000	7793000	5733100	4689700
ACID COMPOUNDS																	
2, 4-DIMETHYLPHENOL								36000				88000 K					
PHENOL								18000 K	7200		367600	447000		24500	130000	114000	119000
BENZOIC ACID									11000 K				1600 K	28200 K			
2-METHYLPHENOL								93100			61300 K	142600		20000	28900 K	130000	23000
4-METHYLPHENOL								52000			87900 K	535600		67800	36700 K	510000	31000
TOTAL ACIDS	0	0	0	0	0	0	0	199100	18200	0	516800	1213200	1600	141300	203600	754000	173000
BASE/NEUTRAL COMPOUNDS																	
1, 2, 4-TRICHLOROBENZENE											389600	49000					119000
1, 2-DICHLOROBENZENE								15900 K	31500		534100	333700		84100	252700	2160000	172000
1, 4-DICHLOROBENZENE									33700		570000						
1, 2-DIPHENYLHYDRAZINE								68600 K									
HEXACHLOROBUTADIENE									5000							4000 K	
ISOPHORONE						40		41900 K	970		409200	44000 K		41700	59300	340000	122000
NAPHTHALENE								30300 K	1500		290300	55700 K		26100	400000	470000	99000
NITROBENZENE									7800								
N-NITROSODIMETHYLAMINE									9900								
N-NITROSODIPHENYLAMINE				40	1400												
N-NITROSODIPROPLYAMINE									12000								
BIS(2-ETHYLHEXYL)PHTHALATE	230	40		40 K	80 K			755200	48300		774600	685900		291900	458100	3800000	226000
BENZYL BUTYL PHTHALATE								1282000	42500		200900	366000	970 K	85000	268000	1800000	61000
DI-N-BUTYL PHTHALATE								67900				79000		14300	112200		11000
DI-N-OCTYL PHTHALATE	10 K							127800	8300	17000 K	78600 K	84000		8900	22600 K	300000	34000
DIETHYL PHTHALATE												35000 K					
DIMETHYL PHTHALATE															25400		
PHENANTHRENE														4600			8000
2-METHYLNAPHTHALENE								7200 K			104000	44900 K		8800 K	55100	130000	31000
TOTAL B/N's	240	40	0	80	1400	40	0	2396800	201470	17000	3359300	1777200	970	565400	1661400	8204000	883000

NOTE: CONCENTRATIONS REPORTED ON A DRY WEIGHT BASIS — SAMPLES ANALYZED FOR ROUTINE ORGANIC PACKAGE, BUT ONLY DETECTED COMPOUNDS ARE LISTED — FOOTNOTES GIVEN ON FOLLOWING PAGE

TABLE 8
SOIL ORGANIC RESULTS (ug/kg)
PHASE I SAMPLING
ECC Site TM 3-4

	SURFACE SOIL SAMPLES FROM NORTH AND NORTHWEST EMBANKMENTS							SURFACE SOIL SAMPLES					SOIL BORING SAMPLES				
Sample Location:	AA	AC	AE	AG	AI	AK	AL	AM-SW	AO-SE	AP-SE	N OF P	N OF PD	AN	AE-AH	AE-AG	B-6	D-7
Depth (ft):	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5			0-0.5	0-0.5	0-0.5	0-0.5	1.5-2
Date Sampled:	5-8-84	5-8-84	5-8-84	5-8-84	5-8-84	5-8-84	5-8-84	5-9-84	5-8-84	5-8-84	5-9-84	5-9-84	5-9-84	5-9-84	5-9-84	5-8-84	5-8-84
OTR Number:	E-7244	E-7245	E-7246	E-7247	E-7248	E-7249	E-7250	E-7255	E-7251	E-7252	E-7253	E-7254	E-7256	E-7257	E-7258	E-7259	E-7260
VOLATILE COMPOUNDS																	
1, 2-DICHLOROETHANE									200								
1, 1, 1-TRICHLOROETHANE								676000	17500	193500	7411400	4510000	40	48000	270000	1203200	635000
1, 1-DICHLOROETHANE										700			60				
CHLOROFORM									580	890			20			41800	17600
TRANS-1, 2-DICHLOROETHENE								34400	79700	1500			100			41800	
CIS-1, 3-DICHLOROPROPENE															12000		
ETHYLBENZENE								262000	600		121200	514000		9000	5649000	155000	120000
METHYLENE CHLORIDE	80	10	10	20	20	50	50	515000	2400	2500	141800	120000	10	34000	35000	65500	94000
CHLOROMETHANE	70																
TETRACHLOROETHENE								4116000	570	4600	617200	625000		131000	238000	630000	744100
TOLUENE								751000	14800		687100	674000		80000	273000	470700	964000
TRICHLOROETHENE							2 K	4214000	1800	2000	6008200	2006000	60	147000	664000	2135700	1375000
VINYL CHLORIDE									6400								
ACETONE									30300								
2-BUTANONE									5200							99200	89600
4-METHYL-2-PENTANONE									730		2600 K	2200 K				7600	29600
STYRENE														5000	19000		13800
TOTAL XYLENES								1160000	15000		707800	345000		97000	633000	882600	607000
TOTAL VOLATILES	150	10	10	20	20	50	52	11720400	175860	206490	15769300	8796200	290	551000	7793000	5733100	4689700
ACID COMPOUNDS																	
2, 4-DIMETHYLPHENOL								36000				88000 K					
PHENOL								18000 K	7200		367600	447000		24500	130000	114000	119000
BENZOIC ACID									11000 K				1600 K	28200 K			
2-METHYLPHENOL								93100			61300 K	142600		20800	28900 K	130000	23000
4-METHYLPHENOL								52000			87900 K	535600		67800	36700 K	510000	31000
TOTAL ACIDS	0	0	0	0	0	0	0	199100	18200	0	516000	1213200	1600	141300	283600	754000	173000
BASE/NEUTRAL COMPOUNDS																	
1, 2, 4-TRICHLOROBENZENE											389600	49000					119000
1, 2-DICHLOROBENZENE								15900 K	31500		534100	333700		84100	252700	2160000	172000
1, 4-DICHLOROBENZENE									33700		570000						
1, 2-DIPHENYLHYDRAZINE								68600 K								4000 K	
HEXACHLOROBUTADIENE									5000								
ISOPHORONE						40		41900 K	970		409200	44000 K		41700	59300	340000	122000
NAPHTHALENE								30300 K	1500		298300	55700 K		26100	408000	470000	99000
NITROBENZENE									7800								
N-NITROSODIMETHYLAMINE									9900								
N-NITROSODIPHENYLAMINE				40	1400												
N-NITROSODIPROPLYAMINE									12000								
BIS(2-ETHYLHEXYL)PHTHALATE	230	40		40 K	80 K			755200	48300		774600	685900		291900	458100	3800000	226000
BENZYL BUTYL PHTHALATE								1282000	42500		200900	366000	970 K	85000	268000	1000000	61000
DI-N-BUTYL PHTHALATE								67900				79000		14300	112200		11000
DI-N-OCTYL PHTHALATE	10 K							127800	8300	17000 K	78600 K	84000		8900	22600 K	300000	34000
DIETHYL PHTHALATE												35000 K					
DIMETHYL PHTHALATE															25400		
PHENANTHRENE														4600			8000
2-METHYLNAPHTHALENE								7200 K			104000	44900 K		8800 K	55100	130000	31000
TOTAL B/N's	240	40	0	80	1480	40	0	2396800	201470	17000	3359300	1777200	970	565400	1661400	8204000	883000

NOTE: CONCENTRATIONS REPORTED ON A DRY WEIGHT BASIS — SAMPLES ANALYZED FOR ROUTINE ORGANIC PACKAGE, BUT ONLY DETECTED COMPOUNDS ARE LISTED — FOOTNOTES GIVEN ON FOLLOWING PAGE

Table 7 (Page 3 of 3)

Test Pit Number	Sample Number	Depth Feet Below Ground Surface	Visual Classification[1]	Total Volatile Organics OVA Screening (ppm)	Comments
TP-11	0-6"	0-0.5	Coarse gravel.	100	Sample sent to CLP
	Shallow	1.0-2.5	Brown clay and sand.	170	
	Medium	5.0-5.5	As above.	90	
	Deep	5.0-5.5	As above.		
TP-12	0-6"	0-0.5	Coarse gravel.		
	Shallow	0.5-3.0	Brown sandy clay.	5,000	Sample sent to CLP
	Medium	3.0-5.0	As above.	4,600	
	Deep	5.0-5.5	As above.	130	

[1] Description of test pit at each depth zone specified.

GLT360/44

TABLE 8
SOIL ORGANIC RESULTS (ug/kg)
PHASE I SAMPLING
ECC Site TM 3-4

Sample Location:	AA	AC	AE	AG	AI	AK	AL	AM-SW	AO-SE	AP-SE	N OF P	N OF PD	AN	AE-AH	AE-AG	B-6	D-7
	SURFACE SOIL SAMPLES FROM NORTH AND NORTHWEST EMBANKMENTS							SURFACE SOIL SAMPLES					SOIL BORING SAMPLES				
Depth (ft):	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5	0-0.5			0-0.5	0-0.5	0-0.5	0-0.5	1.5-2
Date Sampled:	5-8-84	5-8-84	5-8-84	5-8-84	5-8-84	5-8-84	5-8-84	5-9-84	5-8-84	5-8-84	5-9-84	5-9-84	5-9-84	5-9-84	5-9-84	5-8-84	5-8-84
OTR Number:	E-7244	E-7245	E-7246	E-7247	E-7248	E-7249	E-7250	E-7255	E-7251	E-7252	E-7253	E-7254	E-7256	E-7257	E-7258	E-7259	E-7260
PESTICIDES																	
DELTA-BHC												760			260	170	540
GAMMA-BHC (LINDANE)																170	
HEPTACHLOR													10	90	90	210	
ALDRIN															20		
ENDOSULFAN I										40	8300						
DIELDRIN						10		450		140	20	20					700
4, 4-DDE											830	720		100	110	160	
ENDRIN										190	10000			670			11200
ENDOSULFAN II												6300			110		11100
4, 4-DDD															1000		5900
ENDRIN ALDEHYDE											12100	9400					20000
ENDOSULFAN SULFATE											4000	3300					19000
4, 4-DDT	70									500	28900	21000	40	1300	2800	3200	36000
METHOXYCHLOR																	
CHLORDANE											2700	2300					
TOXAPHENE											10000						
TOTAL PESTICIDES	70	0	0	0	0	10	0	450	0	870	77650	43800	50	2160	4470	3910	104440
PCB's																	
AROCHLOR-1016											10000						
AROCHLOR-1232											16200						
AROCHLOR-1248											10000						
TOTAL PCB's	0	0	0	0	0	0	0	0	0	0	37800	0	0	0	0	0	0
DIOXIN																	
2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN																7.6	6.1
PERCENT MOISTURE	14.6%	14.1%	13.8%	11.3%	11.4%	12%	11.8%	16.9%	15.5%	14.2%	48.1%	38.5%	16.9%	13.5%	15%	29.2%	21.6%

FOOTNOTES:
A. Tentatively identified compound concentrations are estimated. A 1:1 response is assumed.
B. Analyte has been found in the laboratory blank as well as the sample. Indicates probable contamination.
C. Applies to pesticide parameters where the identicication has been confirmed by GC/MS.
J. Indicates an estimated value. When mass spectral data indicates the presence of a compound that meets the identification criteria and the result is less than the specified detection limit but greater than zero.
K. Actual value, within the limitations of the method is less than the value given

NOTE: CONCENTRATIONS REPORTED ON A DRY WEIGHT BASIS — SAMPLES ANALYZED FOR ROUTINE ORGANIC PACKAGE, BUT ONLY DETECTED COMPOUNDS ARE LISTED — FOOTNOTES GIVEN ON FOLLOWING PAGE

CLP ORGANIC HSL LIST
ECC SITE

Constituent
ACID COMPOUNDS
2,4,6-trichlorophenol
p-chloro-m-cresol
2-chlorophenol
2,4-dichlorophenol
2,4-dimethyl phenol
2-nitrophenol
4-nitrophenol
2,4-dinitrophenol
4,6-dinitro-2-methyl phenol
pentachlorophenol
phenol
BASE/NEUTRAL COMPOUNDS
acenaphthene
benzidine
1,2,4-trichlorobenzene
hexachlorobenzene
hexachloroethane
bis(2-chloroethyl)ether
2-chloronaphthalene
1,2-dichlorobenzene
1,3-dichlorobenzene
1,4-dichlorobenzene
3,3'-dichlorobenzidine
2,4-dinitrotoluene
2,6-dinitrotoluene
1,2-diphenylhydrazine
fluoranthene
4-chlorophenyl phenyl ether
4-bromophenyl phenyl ether
bis(2-chloroisopropyl)ether
bis(2-chloroethoxy)methane
hexachlorobutadiene
hexachlorocyclopentadiene
isophorone
naphthalene
nitrobenzene
N-nitrosodiphenylamine

Constituent

BASE/NEUTRAL COMPOUNDS (continued)

N-nitrosodipropylamine
bis(2-ethylhexyl)phthalate
benzyl butyl phthalate
di-n-butyl phthalate
di-n-octyl phthalate
diethyl phthalate
dimethyl phthalate
benzo(a)anthracene
benzo(a)pyrene
benzo(b)fluoranthene
benzo(k)fluoranthene
chrysene
acenaphthylene
anthracene
benzo(ghi)perylene
fluorene
phenanthrene
dibenzo(a,h)anthracene
indeno(1,3,3-cd)pyrene
pyrene

VOLATILES

acrolein
acrylonitrile
benzene
carbon tetrachloride
chlorobenzene
1,2-dichloroethane
1,1,1-trichloroethane
1,1-dichloroethane
1,1,2-trichloroethane
1,1,2,2-tetrachloroethane
chloroethane
2-chloroethylvinyl ether
chloroform
1,1-dichloroethene
trans-1,2-dichloropropene
1,2-dichloropropane
trans-1,3-dichlorpropene
cis-1,3-dichloropropene
ethylbenzene
methylene chloride

Constituent
VOLATILES (continued)
chloromethane
bromomethane
bromoform
bromodichloromethane
fluorotrichloromethane
dichloridifluoromethane
chlorodibromomethane
tetrachloroethene
toluene
trichloroethene
vinyl chloride
NONPRIORITY POLLUTANTS HAZARDOUS SUBSTANCES
benzoic acid
2-methylphenol
4-methylphenol
2,4,5-trichlorophenol
aniline
benzyl alcohol
4-chloroaniline
dibenzofuran
2-methylnaphthalene
2-nitroaniline
3-nitroaniline
4-nitroaniline
acetone
2-butanone
carbondisulfide
2-hexanone
4-methyl-2-pentanone
styrene
vinyl acetate
o-xylene
PESTICIDES
aldrin
dieldrin
chlordane
4,4'-DDT
4,4'-DDE
4,4'-DDD

Constituent
PESTICIDES (continued)
a-endosulfan
b-endosulfan
endosulfan sulfate
endrin
endrin aldehyde
heptachlor
heptachlor epoxide
α-BHC
β-BHC
δ-BHC
γ-BHC (lindane)
PCB-1242
PCB-1254
PCB-1221
PCB-1232
PCB-1248
PCB-1260
PCB-1016
toxaphene
DIOXINS
2,3,7,8-tetrachloro-dibenzo-p-dioxin

Inorganic analytical results for soil samples collected during October and November 1984, are presented in Tables 10, 11, and 12. Quality assurance (QA) reviewers indicated that the results were quantitative with some exceptions. Sample results of lead and chromium for samples ME4162 through ME4185 (Table 13) are considered qualitative because there was imprecision in reproducing results in duplicate samples. Results for calcium, magnesium and zinc are considered semi-quantitative because there was some (4 to 15 percent more than allowable) imprecision in reproducing results in duplicate samples.

Inorganic results for antimony, cadmium, and lead are considered semi-quantitative for samples MEA309 through MEA325 and ME4186 (Table 11 and 12), based on recoveries of spiked samples. Reported results for antimony and cadmium may be biased low by about 15 to 35 percent. Results for lead may be biased high by 20 to 40 percent. Results for selenium in these same samples are considered qualitative because spike recoveries are 30 to 50 percent low.

Organic analytical results for Phase 2 soil samples are presented in Table 13, 14, and 15. Phase 2 soil organics were analyzed in three groups and there is a review for each group. Dioxin was not analyzed for in Phase 2.

The first review covers organic traffic report numbers E4901 through E4915. Based on Average Surrogate Percent Recovery (ASPR) and Coefficient of variation (Cv) the volatile, acid and base neutral results are quantitative. Several volatile laboratory blanks had acetone, 2-butanone, trichloroethene and methylene chloride contamination. The affected sample result are marked with a B after the result. Pesticide/PCB results are qualitative based on ASPR and Cv.

The second review covers samples E4916 through E4930. The laboratory failed to meet required holding times for all volatile and Pesticide/PCB samples. Samples E4917, E4922, E4926, E4927, E4928, and E4930, the acid, base/neutral samples were not analyzed within required holding times. Based on ASPR, Cv, and failure of the laboratory to meet required holding times, the results are semi-quantitative.

The last Phase 2 organic review covers samples E4931 through E4935 and E8077. Acetone and 2-butanone were found in some laboratory blanks. The affected sample results are marked with a B after the result. Based on ASPR and Cv, volatiles

TABLE 10
SOIL INORGANIC RESULTS (mg/kg)
TEST PITS
SHALLOW DEPTH SAMPLES
ECC Site TM 3-4

Sample Location:	TP-1	TP-2	TP-3	TP-4	TP-5	TP-5	TP-6	TP-6	TP-7	TP-8	TP-9	TP-10	TP-11	TP-12
Depth (ft):	1-1.5	1-1.5	1-1.5	1-2	1-2	2-3	1-2	2-3	1-2.5	1-2.5	1-3	1-3	1-2.5	0.5-3
Date Sampled:	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-23-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
ITR Number:	ME4162	ME4164	ME4165	ME4166	ME4168	ME4169	ME4170	ME4171	ME4177	ME4179	ME4181	ME4183	ME4184	ME4185
INORGANIC COMPOUNDS														
ALUMINUM	6650	9990	44800	8000	4720	4870	8310	7180	4950	5630	3290	8310	10600	5900
ANTIMONY														
ARSENIC	7.1	17	5.6	[5.9]	9.7	16	11	7.4	7.7	11	8.6	[4.8]	6.1	8.9
BARIUM	[82]	[73]	[280]	[65]	[42]	[45]	[82]	1570	[81]	[51]	[82]	[119]	[69]	[49]
BERYLLIUM	[0.6]	[0.64]	[3.9]	[0.47]		[0.37]	[0.45]	[1.4]			[0.79]	[0.56]	[0.67]	[0.44]
CADMIUM	4.1							3.8			4.5			
CALCIUM	65100 *	7950 *	1260000	[2500] *	101000 *	103000 *	23000 *	57800 *	93200 *	110000 *	50100 *	76700 *	3010 *	104000 *
CHROMIUM	55 *	22 *	116	15 *	15 *	12 *	93 *	131 *	42 *	13 *	44 *	53 *	23 *	14 *
COBALT	[8.1]	[14]	[51]	[6.5]	[5.1]	[6.1]	[12]	[12]	[6.8]	[8.1]	[6.8]	[8.3]	[5.8]	[6.6]
COPPER	38	30	167	[13]	18	17	34	77	31	21	28	39	25	28
IRON	16700	27000	147000	15300	15000	15100	15500	18800	13400	16200	11900	19300	23600	17000
LEAD	132. *	13 *	7.8	11 *	9.1	12	142 *	393 *	135 *	20	155 *	189 *	11	8.9
CYANIDE	1.3						0.80		2.9					
MAGNESIUM	19400 *	5790 *	292000	[2060] *	28000 *	30000 *	8800 *	11100 *	41500 *	35100 *	19500 *	22400 *	3040 *	29900 *
MANGANESE	438	485	2840	473	382	327	299	6240	366	371	158	407	109	324
MERCURY														
NICKEL	[20]	37	[164]	[12]	[18]	[19]	[14]	[13]	[5.8]	[11]	[18]	[22]	25	[21]
POTASSIUM	[1290]	[1570]	[10500]		[1160]	[1360]	[1040]	[985]	[2020]	[1140]	[1090]	[1380]	[1040]	[1410]
SELENIUM														
SILVER	[3.8]													
SODIUM		[485]	[15600]		[1270]	[1630]		[630]			[589]			
THALLIUM														
TIN	[21]			[20]	25						[24]	[22]		
VANADIUM	[22]	32	[167]	[22]	[16]	[17]	[24]	33	[15]	[19]	[15]	[24]	35	[19]
ZINC	121 *	90 *	477	43 *	48 *	56 *	164 *	517 *	232 *	73 *	122 *	650 *	82 *	59 *
PERCENT SOLIDS	78%	84%	90%	85%	88%	90%	88%	88%	84%	87%	76%	84%	90%	90%

FOOTNOTES:

E- Value is estimated or not reported due to the presence of interference.
*- Duplicate analysis is not within control limits.
+- Correlation coefficient for method of standard addition is less than 0.995.
[]- Positive values less than the contract required detection limit.

NOTE: CONCENTRATIONS ARE REPORTED ON A DRY WEIGHT BASIS —

TABLE 11
SOIL INORGANIC RESULTS (mg/kg)
TEST PITS
INTERMEDIATE DEPTH SAMPLES
ECC Site TN 3-4

Sample Location:	TP-1	TP-4	TP-6	TP-7	TP-8	TP-9	TP-10	TP-11	TP-12
Depth (ft):	4-5	2.5-3.5	4-5	2.5-4	2.5-4	3-5	3-5	3-5	3-5
Date Sampled:	10-22-84	10-22-84	10-22-84	10-23-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
ITR Number:	ME4163	ME4167	ME4172	ME4178	ME4180	ME4182	MEA312	MEA313	MEA314
INORGANIC COMPOUNDS									
ALUMINUM	4620	13200	7920	5170	4670	5150	9970	5200	5040
ANTIMONY	42								
ARSENIC	[6.1]	20	[4.9]	0.4		7.5	15	[6.0]	6.2
BARIUM	[33]	137	1730	[49]	[86]	[47]	[63]	[40]	[46]
BERYLLIUM		[0.74]	[1.5]		[2]	[0.43]	[0.40]		
CADMIUM			4.9		27	2.9			
CALCIUM	70100 *	5060 *	63000 *	92000 *	87500 *	97700 *	3000	113000	10000
CHROMIUM	13 *	25 *	145 *	12 *	40 *	12 *	20	13	15
COBALT	[7.1]	[13]	[13]	[0.7]	[9.4]	[7.1]	[11]	[0.5]	[11]
COPPER	19	27	85	19	38	18	22	21	20
IRON	14000	31500	20700	15600	14500	15800	22100	17400	16500
LEAD	0.5	15 *	432 *	54	142 *	15	12	7.7	6.7
CYANIDE				0.96	4.4				
MAGNESIUM	23000 *	3740 *	12300 *	26700 *	25300 *	27400 *	3110	27900	25700
MANGANESE	352	700	6870	479	295	379	204 *	403 *	389 *
MERCURY									
NICKEL	[17]	36	[15]	[13]	[23]	[17]	[24]	[20]	[19]
POTASSIUM	[935]	[1040]	[1030]	[1090]	[1390]	[1260]	[1900]	[1700]	[1500]
SELENIUM									
SILVER		[3.0]							
SODIUM	[1100]		[400]				[634]	[1560]	[1910]
THALLIUM									
TIN					[21]				
VANADIUM	[17]	36	37	[19]	[17]	[17]	31	[19]	[20]
ZINC	53 *	90 *	570 *	62 *	613 *	62 *	70	53	51
PERCENT SOLIDS	82%	81%	82%	89%	78%	93%	82%	84%	89%

FOOTNOTES:

E- Value is estimated or not reported due to the presence of interference.
*- Duplicate analysis is not within control limits.
+- Correlation coefficient for method of standard addition is less than 0.995.
[]- Positive values less than the contract required detection limit.

NOTE: CONCENTRATIONS ARE REPORTED ON A DRY WEIGHT BASIS --

TABLE 12
SOIL BORING INORGANIC RESULTS (mg/kg)
ECC Site TM 3-4

INTERMEDIATE BORINGS

Sample Location:	SB-01	SB-02	SB-04	SB-05	SB-05	SB-06	SB-08	SB-09
Depth (ft):	2.5-4	2.5-4	2-3.5	3-4.5	3-4.5	2-3.5	2.5-4	2.5-4
Date Sampled:	10-24-84	10-22-84	10-24-84	10-24-84	10-24-84	10-23-84	10-24-84	10-24-84
ITR Number:	ME4186	MEA310	MEA320	MEA325	MEA324	MEA318	MEA317	MEA316
INORGANIC COMPOUNDS								
ALUMINUM	5260	4500	6660	4650	5140	5110	6540	5300
ARSENIC	[4.9]	8.6	8.5	10	[4.6]	7.8	7.3	10
BARIUM	[35]	[45]	[54]	[54]	[49]	[35]	[48]	[32]
BERYLLIUM				[.38]		[.36]	[.37]	[.38]
CADMIUM							4.4	
CALCIUM	110000	102000	100000	121000	109000	109000	104000	113000
CHROMIUM	15	12	15	13	12	13	18	14
COBALT	[5]	[11]	[10]	[10]	[9.6]	[6.6]	[11]	[9.5]
COPPER	23	18	25	21	21	20	26	20
IRON	16000	15300	19000	19200	16100	14400	20500	16400
LEAD	7.2	9.3	9.1	26	5.6	8.3	9	7.7
MAGNESIUM	26400	28600	27300	27000	30400	33300	28700	34100
MANGANESE	289 *	344 *	451 *	409 *	314 *	306 *	401 *	316 *
NICKEL	[13]	[15]	23	[19]	[18]	[18]	24	[13]
POTASSIUM	[1400]	[1630]	[1750]	[1550]	[1750]	[1640]	[2030]	[1450]
SILVER							[3.3]	
SODIUM	[859]	[944]	[1640]	[1090]	[900]	[1290]	[1400]	[1390]
TIN			30	19	17			
VANADIUM	[20]	[16]	[23]	[18]	[20]	[19]	[25]	[20]
ZINC	51	47	69	54	66	55	68	56
PERCENT SOLIDS	90%	81%	88%	92%	90%	90%	89%	91%

DEEP BORINGS

Sample Location:	SB-01	SB-02	SB-04	SB-05	SB-05	SB-08	SB-09
Depth (ft):	5.5-7	5.5-7	5-6.5	7.5-9	7.5-9	7-8.5	5.7-7
Date Sampled:	10-22-84	10-22-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
ITR Number:	MEA309	MEA311	MEA319	MEA323	MEA322	MEA321	MEA315
INORGANIC COMPOUNDS							
ALUMINUM	5100	4100	4370	3400	3390	4421	6840
ARSENIC	6.5	7.2	[4.6]	[3.7]	[4.5]	5.5	15
BARIUM	[81]	[35]	[38]	[27]	[29]	[40]	[44]
BERYLLIUM							[.39]
CADMIUM	4.1						
CALCIUM	104000	107000	108000	107000	140000	119000	68800
CHROMIUM	15	11	13	9.6	10	9.8	17
COBALT	[8.5]	[6.6]	[9.9]	[7.1]	[6.8]	[6.5]	[6.5]
COPPER	18	18	23	19	21	18	24
IRON	15100	14300	16400	13200	13800	15100	20700
LEAD	6.5	7.2	7.1	4.5	5	7.1	17
MAGNESIUM	27400	28000	29500	24800	28700	30200	21300
MANGANESE	555 *	334 *	337 *	285 *	405 *	309 *	390
NICKEL	[20]	15	[19]	[13]	[15]	[16]	[18]
POTASSIUM	[1490]	[1620]	[1630]	[1240]	[1200]	[1590]	[1190]
SILVER							
SODIUM	[673]	[958]	[1430]	[983]	[1100]	[1210]	[1190]
TIN							
VANADIUM	[19]	[15]	[17]	[16]	[15]	[15]	[22]
ZINC	47	56	44	54	[38]	41	65
PERCENT SOLIDS	92%	90%	91%	93%	92%	91%	84%

FOOTNOTES:

E- Value is estimated or not reported due to the presence of interference.
*- Duplicate analysis is not within control limits.
+- Correlation coefficient for method of standard addition is less than 0.995.
[]- Positive values less than the contract required detection limit.

NOTE: CONCENTRATIONS REPORTED ON A DRY WEIGHT BASIS are quantitative except results for acetone and 2-butanone. There were calibration problems for these compounds. Pesticide/ PCB data is quantitative based on ASPR and Cv. Base/neutral and acid sample results are quantitative based on ASPR, Cv, and calibration check results.

Organic analytical results for Phase 2 soil sample are presented in Table 13, 14, and 15.

No effort has been made to interpret these results. Evaluation of the analytical results from soil samples will be performed in Task 4 of the remedial investigation (RI) and presented in the RI report.

GLT360/25

TABLE 13
SOIL ORGANIC RESULTS (ug/kg)
TEST PITS
SHALLOW DEPTH SAMPLES
ECC Site TN 3-4

Sample Location:	TP-1	TP-2	TP-3	TP-4	TP-5	TP-5	TP-6	TP-6	TP-7	TP-8	TP-9	TP-10	TP-11	TP-12
Depth (ft):	1-1.5	1-1.5	1-1.5	1-2	1-2	2-3	1-2	2-3	1-2.5	1-2.5	1-3	1-3	1-3	1-3
Date Sampled:	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-23-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
OTR Number:	E4901	E4903	E4904	E4905	E4907	E4908	E4909	E4910	E4916	E4918	E4920	E4922	E4924	E4926
VOLATILE COMPOUNDS														
CHLOROBENZENE				360										
1, 1, 1-TRICHLOROETHANE			5400				1100000				130000			6400
1, 1, 2-TRICHLOROETHANE														550
1, 1-DICHLOROETHENE							35000 B							240
TRANS-1, 2-DICHLOROETHENE					79		120000 B					9		
ETHYLBENZENE				2800		21 B	560000		21000		1500000			
METHYLENE CHLORIDE	93 B	28 B	2800 B	820 B	260 B		140000 B	250 B	2900	53	310000	76	130	1600
TETRACHLOROETHENE	9 J		2900	570			650000		1100		74000	8		290
TOLUENE			1600		88	6	1100000		27000		2000000			1200
TRICHLOROETHENE			3400 B	200 B	580		4000000 B		6000	14	150000	15		410
VINYL CHLORIDE														
ACETONE			50000 B	39000 B	7600	62		8900	17000		650000			12000
2-BUTANONE			37000 B	33000 B	13000	150		13000	24000		2800000			12000
4-METHYL-2-PENTANONE			4600	2500	990	52		300	12000		190000			
TOTAL XYLENES				18000			2000000		120000		6800000			
TOTAL VOC's	102	28	107700	97330	22597	291	10505000	22450	231000	67	14604000	108	130	34690
ACID COMPOUNDS														
PHENOL							570000							
2-METHYLPHENOL														
4-METHYLPHENOL							53000							
TOTAL ACIDS	0	0	0	0	0	0	623000	0	0	0	0	0	0	0
BASE/NEUTRAL COMPOUNDS														
1, 2-DICHLOROBENZENE	1600			2400			900000	240	36000	3800				
ISOPHORONE	270 J		1100		1700		440000			470		850		340
NAPHTHALENE				1800			180000		60000	710	78000			
BIS(2-ETHYLHEXYL)PHTHALATE	15000			5700			370000	1200	61000	6300	59000	27000		
BUTYL BENZYL PHTHALATE	1500								47000	3500		950		
DI-N-BUTYL PHTHALATE				690					8200			900		
DI-N-OCTYL PHTHALATE	2100			1500						340				
DIMETHYL PHTHALATE														
FLUORENE														
PHENANTHRENE				450							8100			
2-METHYLNAPHTHALENE				2100										
TOTAL B/N COMPOUNDS	20470	0	1100	14640	1700	0	1890000	1440	212200	15120	145100	29700	0	340
PCB's														
AROCHLOR-1232				340 C										
AROCHLOR-1260	970										39000	750		
TOTAL PCB's	970	0	0	340	0	0	0	0	0	0	39000	750	0	0

NOTE: CONCENTRATIONS ARE REPORTED ON A DRY WEIGHT BASIS — SAMPLES ANALYZED FOR ROUTINE ORGANIC PACKAGE, BUT ONLY DETECTED COMPOUNDS ARE LISTED — FOOTNOTES GIVEN ON FOLLOWING PAGE

TABLE 13
SOIL ORGANIC RESULTS (ug/kg)
TEST PITS
SHALLOW DEPTH SAMPLES
ECC Site TN 3-4

Sample Location:	TP-1	TP-2	TP-3	TP-4	TP-5	TP-5	TP-6	TP-6	TP-7	TP-8	TP-9	TP-10	TP-11	TP-12
Depth (ft):	1-1.5	1-1.5	1-1.5	1-2	1-2	2-3	1-2	2-3	1-2.5	1-2.5	1-3	1-3	1-3	1-3
Date Sampled:	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-22-84	10-23-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
OTR Number:	E4901	E4903	E4904	E4905	E4907	E4908	E4909	E4910	E4916	E4918	E4920	E4922	E4924	E4926
TENTATIVELY IDENTIFIED COMPOUNDS	A													
ETHYLBENZENE									37000					
UNDECANE				20000					75000					
4-METHYL-4-HYDROXYL-2-PENTANONE														
NONANE														
DECANE				20000			400000			5900				
ETHYLBENZENE			600							12000	270000			
ETHYL-METHYL-BENZENE														
TRIDECANE				10000						24000	270000			
PENTADECANE										35000				
HEXADECANE				20000				2000		9500				
HEPTADECANE				10000						12000				
OCTADECANE											140000			
SULFUR														
TOLUENE										47000	680000			4700
4-METHYL-2-PENTANONE										4700				
TETRACHLOROETHENE										24000				
PHTHALATE										9500				
BUTYL CELLOSOLVE														
t-BUTYL ALCOHOL												60		
PHENYL ETHER												12000		
2,6-BIS(1,1-DIMETHYLETHYL)-2,5-CYCLOHEXADIENE-1,4-DIONE												1200		
2,6-BIS(1,1-DIMETHYLETHYL)-4-METHYLPHENOL												47000		
3,3,5-TRIMETHYLCYCLOHEXANONE				10000	1000			3000						
1,1,2,2-TETRACHLOROETHANE														
PENTANOIC ACID														
HEXANOIC ACID														
DIETHYL ETHER														800
4-HYDROXY-4-METHYL-2-PENTANONE														2400
2-BUTANOL														
NONADECANE											270000			
PHTHALIC ACID	1000						500000							
TOLUENE-2,4-DIISOCYANATE	5000													
2,4-DIMETHYL-3-PENTANONE			600											
TETRADECANE				10000										
DODECANE							800000							
1-METHYL-2-PYRROLIDINONE								7000						
LAURIC ACID								1000						
PERCENT MOISTURE	19.2	15.0	11.1	16.0	10.4	8.7	19.0	13.5	19.8	15.4	26.0	15.1	13.8	10.3

FOOTNOTES:
A. Tentatively identified compound concentrations are estimated. A 1:1 response is assumed.
B. Analyte has been found in the laboratory blank as well as the sample. Indicates probable contamination.
C. Applies to pesticide parameters where the identicication has been confirmed by GC/MS.
J. Indicates an estimated value. When mass spectral data indicates the presence of a compound that meets the identification criteria and the result is less than the specified detection limit but greater than zero.
K. Actual value, within the limitations of the method is less than the value given

TABLE 14
SOIL ORGANIC RESULTS (ug/kg)
TEST PITS
INTERMEDIATE DEPTH SAMPLES
ECC Site TM 3-4

Sample Location:	TP-1	TP-4	TP-6	TP-7	TP-8	TP-9	TP-10	TP-11	TP-12
Depth (ft):	4-5	2.5-3.5	4-5	2.5-4	2.5-4	3-5	3-5	3-5	3-5
Date Sampled:	10-22-84	10-22-84	10-22-84	10-23-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
OTR Number:	E4902	E4906	E4911	E4917	E4919	E4921	E4923	E4925	E4927
VOLATILE COMPOUNDS									
CHLOROBENZENE									
1, 1, 1-TRICHLOROETHANE					7700				1900
1, 1, 2-TRICHLOROETHANE									62
1, 1-DICHLOROETHENE									47
TRANS-1, 2-DICHLOROETHENE									9
ETHYLBENZENE				20000	10000		14		
METHYLENE CHLORIDE	17	16 B	16	4400	1900	110	59	67	82
TETRACHLOROETHENE				26000	29000				
TOLUENE				10000	19000		13		120
TRICHLOROETHENE				1000	66000	13	6		86
VINYL CHLORIDE						7			
ACETONE				53000	41000				590
2-BUTANONE				64000	87000				630
4-METHYL-2-PENTANONE					13000				83
TOTAL XYLENES				100000	41000				
TOTAL VOC's	0	16	16	279200	315600	130	92	67	3609
ACID COMPOUNDS									
PHENOL					25000				
2-METHYLPHENOL							340		
4-METHYLPHENOL									
TOTAL ACIDS	0	0	0	0	25000	0	340	0	0
BASE/NEUTRAL COMPOUNDS									
1, 2-DICHLOROBENZENE		4400	2400	890	76000				
ISOPHORONE					17000				
NAPHTHALENE		2100		640	12000				
BIS(2-ETHYLHEXYL)PHTHALATE		7700	2600	680	25000				
BUTYL BENZYL PHTHALATE			540		5900				
DI-N-BUTYL PHTHALATE					3900				
DI-N-OCTYL PHTHALATE									
DIMETHYL PHTHALATE					1300				
FLUORENE				260					
PHENANTHRENE				350	650				
2-METHYLNAPHTHALENE				1900					
TOTAL B/N's	0	14200	5540	4720	141750	0	0	0	0
PCB's									
AROCHLOR-1232		540 C							
AROCHLOR-1260					1700				
TOTAL PCB's	0	540	0	0	1700	0	0	0	0

NOTE: CONCENTRATIONS REPORTED ON A DRY WEIGHT BASIS — SAMPLES ANALYZED FOR ROUTINE ORGANIC PACKAGE, BUT ONLY DETECTED COMPOUNDS ARE LISTED — FOOTNOTES GIVEN ON FOLLOWING PAGE

TABLE 14
SOIL ORGANIC RESULTS (ug/kg)
TEST PITS
INTERMEDIATE DEPTH SAMPLES
ECC Site TN 3-4

Sample Location:	TP-1	TP-4	TP-6	TP-7	TP-8	TP-9	TP-10	TP-11	TP-12
Depth (ft):	4-5	2.5-3.5	4-5	2.5-4	2.5-4	3-5	3-5	3-5	3-5
Date Sampled:	10-22-84	10-22-84	10-22-84	10-23-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
OTR Number:	E4902	E4906	E4911	E4917	E4919	E4921	E4923	E4925	E4927
TENTATIVELY IDENTIFIED COMPOUNDS	A								
ETHYLBENZENE									
UNDECANE		20000		4700	34000				
4-METHYL-4-HYDROXYL-2-PENTANONE				5900					
NONANE				2400	90000				
DECANE		30000			45000				
ETHYLBENZENE				1200					
ETHYL-METHYL-BENZENE									
TRIDECANE				5900					
PENTADECANE				9400	11000				
HEXADECANE		20000	2000						
HEPTADECANE		10000		5900	22000				
OCTADECANE				6000					
SULFUR				3500			2400		
TOLUENE				2400			35000		
4-METHYL-2-PENTANONE					67000				
TETRACHLOROETHENE					220000			800	
PHTHALATE									
BUTYL CELLOSOLVE					34000				
t-BUTYL ALCOHOL							80		
PHENYL ETHER									
2,6-BIS(1,1-DIMETHYLETHYL)-2,5-CYCLOHEXADIENE-1,4-DIONE									
2,6-BIS(1,1-DIMETHYLETHYL)-4-METHYLPHENOL									
3,3,5-TRIMETHYLCYCLOHEXANONE							240		
1,1,2,2-TETRACHLOROETHANE							900		
PENTANOIC ACID							2400		
HEXANOIC ACID							4700		
DIETHYL ETHER									
4-HYDROXY-4-METHYL-2-PENTANONE									
2-BUTANOL									
NONADECANE		9000							
PHTHALIC ACID									
TOLUENE-2, 4-DIISOCYANATE									
2, 4-DIMETHYL-3-PENTANONE									
TETRADECANE									
DODECANE		10000							
1-METHYL-2-PYRROLIDINONE									
LAURIC ACID									
PERCENT MOISTURE	12.2	11.5	17.1	15.0	10.8	9.2	15.3	16.3	10.7

FOOTNOTES:
A. Tentatively identified compound concentrations are estimated. A 1:1 response is assumed.
B. Analyte has been found in the laboratory blank as well as the sample. Indicates probable contamination.
C. Applies to pesticide parameters where the identicication has been confirmed by GC/MS.
J. Indicates an estimated value. When mass spectral data indicates the presence of a compound that meets the identification criteria and the result is less than the specified detection limit but greater than zero.
K. Actual value, within the limitations of the method is less than the value given

TABLE 15
SOIL BORING ORGANIC RESULTS (ug/kg)
ECC Site TM 3-4

	INTERMEDIATE BORINGS								DEEP BORINGS				
Sample Location:	SB-01	SB-02	SB-03*	SB-03*	SB-04	SB-06	SB-08	SB-09	SB0104	SB0204	SB0403	SB0805	SB0904
Depth (ft):	2.5-4	2.5-4	2.5-4	2.5-4	2-3.5	2-3.5	2.5-4	2.5-4	5.5-7	5.5-7	5-6.5	7-8.5	5.7-7
Date Sampled:	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
OTR Number:	E4912	E4914	E4920	E4929	E4934	E4932	E4931	E0077	E4913	E4915	E4933	E4935	E4930
VOLATILE COMPOUNDS													
1, 1, 1-TRICHLOROETHANE	14	49000	11000	65	3 J	27000	27 J	18000				11	110
1, 1-DICHLOROETHANE								380 J					
1, 1, 2-TRICHLOROETHANE			150		14								
CHLOROFORM	57	2900										5 J	
1, 1-DICHLOROETHENE		1600											
TRANS-1, 2-DICHLOROETHENE	37	1500			17		72					41	29
ETHYLBENZENE	15	21000				4800	27 J						
METHYLENE CHLORIDE	100 B	10000 B	1900	74	8	4100	59 B	1050	27 B	34 B	33	54	190
TETRACHLOROETHENE	44	11000			5 J	18000	26 J					8	
TOLUENE	52	31000	680			11000	170	20000	21	10		14	120
TRICHLOROETHENE	39	68000	340			110000	16 J	640				3 J	76
ACETONE	1400		32000	550	16	17000	380 B	10000	66		18 B	41 B	6500
2-BUTANONE	1200	17000	24000	550	6 J	8000 JB	410 B	6600 B					1000
2-HEXANONE					70		1600	920					
4-METHYL-2-PENTANONE	250			36			35 J						44
TOTAL XYLENES	95	110000			36	21000	190	2800				11	
TOTAL VOC's	3303	12900	70070	1275	175	220900	3012	60390	27	34	51	188	8069
ACID COMPOUNDS													
PHENOL						610		1100					
2-METHYLPHENOL													
4-METHYLPHENOL													
TOTAL ACIDS	0	0	0	0	0	610	0	1100	0	0	0	0	0
BASE/NEUTRAL COMPOUNDS													
ISOPHORONE						500							
NAPHTHALENE		640											
BIS(2-ETHYLHEXYL)PHTHALATE	230						730					270 J	
BUTYL BENZYL PHTHALATE								400 J					
DI-N-BUTYL PHTHALATE					420 JB	400 JB	53	320 JB			310 B		
DIETHYL PHTHALATE		9000				1200							
DIMETHYL PHTHALATE		1200				360 J							
TOTAL B/N COMPOUNDS	230	10840	0	0	420	2460	783	720	0	0	0	0	0

NOTE: CONCENTRATIONS REPORTED ON A DRY WEIGHT BASIS -- SAMPLES ANALYZED FOR ROUTINE ORGANIC PACKAGE BUT ONLY DETECTED COMPOUNDS ARE LISTED -- FOOTNOTES GIVEN ON FOLLOWING PAGE

TABLE 15
SOIL BORING ORGANIC RESULTS (ug/kg)
ECC Site TM 3-4

	INTERMEDIATE BORINGS								DEEP BORINGS				
Sample Location:	SB-01	SB-02	SB-03*	SB-03*	SB-04	SB-06	SB-08	SB-09	SB0104	SB0204	SB0403	SB0805	SB0904
Depth (ft):	2.5-4	2.5-4	2.5-4	2.5-4	2-3.5	2-3.5	2.5-4	2.5-4	5.5-7	5.5-7	5-6.5	7-8.5	5.7-7
Date Sampled:	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84	10-24-84
OTR Number:	E4912	E4914	E4928	E4929	E4934	E4932	E4931	E8077	E4913	E4915	E4933	E4935	E4930
PESTICIDE COMPOUNDS													
NONE DETECTED													
PCB's													
NONE DETECTED													
TENTATIVELY IDENTIFIED COMPOUNDS A													
DECANE		900											
UNDECANE		1000											
TRICHLOROFLUOROMETHANE											10 J	12 J	
4-METHYL-2-PENTANOL					4 J								
TETRACHLOROETHENE					4 J								
1, 1, 2-TRICHLORO-1, 2, 2-TRIFLUOROETHANE								24000 J					
ISOPROPYL ALCOHOL				110 J									
2-BUTANOL				90 J									
DIETHYL ETHER													40 J
HEXANE													50
PERCENT MOISTURE	13.7	11.4	11.59	11.06	12	10	12	8	10.7		11	8	14.5

FOOTNOTES:

A. Tentatively identified compound concentrations are estimated. A 1:1 response is assumed.
B. Analyte has been found in the laboratory blank as well as the sample. Indicates probable contamination.
C. Applies to pesticide parameters where the identicication has been confirmed by GC/MS.
J. Indicates an estimated value. When mass spectral data indicates the presence of a compound that meets the identification criteria and the result is less than the specified detection limit but greater than zero.
K. Actual value, within the limitations of the method is less than the value given
* Duplicate samples were taken at SB-03

NOTE: CONCENTRATIONS REPORTED ON A DRY WEIGHT BASIS — SAMPLES ANALYZED FOR ROUTINE ORGANIC PACKAGE BUT ONLY DETECTED COMPOUNDS ARE LISTED —

TECHNICAL MEMORANDUM
Subtask 3-4

Appendix A
SOIL BORING AND TEST PIT LOGS

CH2M HILL

PROJECT NUMBER	BORING NUMBER
	SB-02 SHEET 1 OF

SOIL BORING LOG

PROJECT ECC LOCATION North Central Conc. Pad

ELEVATION DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT

WATER LEVEL AND DATE START 10-22-84, 4:00pm FINISH 5:30 LOGGER BJB

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0					0-6" Conc. PAD		0- Bkgd 2½ ppm
	1–2	X	SB-02 -01	16"	18-11-12	0-12" Coarse Gravel up to 3" Diameter 12-16" Dark brown-gray gravelly sandy silt. dense. some reddish variegation or mottles moist.		HNu readings up to 15 ppm
	3–4	X	SB-02 -02 [CLP]	11"	6-14-18	reddish brown + gray brown variegated silty clay with gravel, dense.		HNu reading up to 6 ppm
	4–5	X	SB-02 -03	18"	4-8-11	0-6" Same as above [SB-02-03A] 6-18" Dark brown silty clay some gravel Firm. Few reddish brown mottles. moist [SB-02-03 B]		0-6" slightly above bkgd. on HNu 6-18" Nothing
	6–7	X	SB-02 -04 [CLP]	13"	6-60	Same as above except very few mottles (red). abundant fine gravel.		Nothing on HNu
	7–9	X	SB-02 -05	18"	6-10-15	Same as above. except less dense or Firm.		nothing on HNu
	9–10	X	SB-02 -06	7"	6-7-19	Same as above.		Nothing on HNu
	11–12	X	SB-02 -07	18"	4-9-16	Same as above		Nothing on HNu

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET	OF
	SB-01		

SOIL BORING LOG

PROJECT ______ LOCATION 230' W + 24' S of NE corner of S Cim Pad

ELEVATION ______ DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT ______

WATER LEVEL AND DATE ______ START ______ FINISH 3:00 PM LOGGER ______

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	1							
	2		SB-01 -01					
	3		SB-01 -02 [CLP]			0-4" Dark Brown gravelly silt firm. 4"-14" Reddish Brown gravelly ~~sandy~~ silty clay Firm. some slight mottles.		HNu 1-2 ppm above bkgd from 0-4"
	4							
	5		SB-01 -03	12"	5-10-12	Same as above		Nothing on HNu
	6		SB-01 -04 [CLP]	18"	4-~~10~~ 15	same as above. Few sandy lenses last 2" changes to Dark brown with some red. brown lenses.		Nothing on HNu
	7							
	8		SB-01 -05	13"	16-19-13	0-4" Dark brown silty sandy clay. some reddish brown sandy lenses. moist 4-13" dark brown silty clay. with sand + fine gravel		Nothing on HNu
	9		SB-01 -06	10"	10-12-13	Dark brown silty clay. Some fine gravel and fine to coarse sand. Firm, moist. gravel up to 1/4".		Nothing on HNu
	10							
	11		SB-01 -07	18"	8-11-14	Dark brown silty clay. Same as above at 8" to 10" fine to med. sand lense. wet.		Nothing on HNu. sample collected from sand lense.
	12							Rods wet at about 10.5 Feet

CH2M HILL

PROJECT NUMBER	BORING NUMBER SB-04	SHEET 1 OF

SOIL BORING LOG

PROJECT: ECC
LOCATION: ~80'S + 50'W of the NE corner of Pad
ELEVATION:
DRILLING CONTRACTOR: ATEC
DRILLING METHOD AND EQUIPMENT: Hollow stem auger 6" OD
WATER LEVEL AND DATE:
START: 10-23-84, 11:15 am
FINISH: 1:30 pm
LOGGER: [illegible]

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0–2					0–1' Conc. Pad		HNu bkgd 2 - 2.5 ppm
	2–3.5	X	SB-04 -01 [CLP]	18"	7-14-20	0-4" gray brown gravelly sandy silt 4"-18" reddish brown gravelly silty clay some sand lenses (<1") gray mottling. firm moist firm		HNu reading up to 15 ppm lower on sample up to 10 ppm
	3.5–5	X	SB-04 02	18"	9-8-13	Same as lower portion of above		HNu up to 6 ppm
	5–6.5	X	SB-04 -03 [CLP]	14"	6-9-8	0-4" same as above 4-10" dark gray brown silty sandy clay lenses of dirty fine sand no mottles firm moist		HNu 1 ppm above bkgd
	6.5–8	X	SB-04 -04	18"	6-9-11	Same as above		Nothing on HNu
	8–9.5	X	SB-04 -05	18"	6-8-4	Same as above		Nothing on HNu
	9.5–11	X	SB-04 -06	16"	7-7-11	Same as above		HNu up to 5 ppm
	11–12.5	X	SB-04 -07	12"	4-8-11	Same as above		
	12.5–							* Water on Rods up to about 6' depth

CH2M HILL

PROJECT NUMBER

BORING NUMBER SB-01 SHEET 1 OF

SOIL BORING LOG

PROJECT ECC LOCATION TP AREA 2, NE PAD CORNER

ELEVATION DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT HOLLOW STEM AUGER

WATER LEVEL AND DATE START 1:30 pm 10-22-88 FINISH LOGGER BJB

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
						0-6" Concrete Pad		HNu reading in hole (6"-12") of 7 to 10 ppm.
	1							
	2		SB-01 -01	10"	21-13-10	0-7" Gravel (angular) Fill. Dark Gray Fragments up to 3" Diam. 7-10" Gravelly Sandy Silt, Dark brown. Firm, moist, ML. Gravel up to ½" Diam		40ml VOA sample (SB-01-01) not enough recovery for CLP.
	3				3-7-12			
	4		SB-01 -02	14"				
	5							
	6							
	7				5-10-12			
	8							
	9							
	10							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER SB-06	SHEET 1 OF

SOIL BORING LOG

PROJECT ECC LOCATION ±60' south of SB-04 Conc. Pad

ELEVATION ______ DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT Hollow Stem Auger

WATER LEVEL AND DATE ______ START 10-23-94, 3:00pm FINISH 5:00pm LOGGER BJB

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0–1					0–1' Concrete Pad		
	2–3		SB-06 -01 [CLP]	16"	6-11-18	reddish brown silty clay w/gravel iron staining on fracture surfaces + mottled. Firm		HNu reading over 200ppm
	3–5		SB-06 -02	18"	5-13-15	0-3" same as above; 3-18" med to light brown fine to med sand with fines. wet. loose.		HNu reading up to 350ppm
	5–6.5		SB-06 -03	18"	10-14-14	0-4" sand lenses + silty clay w/gravel; 4-18" silty clay w/gravel firm some reddish mottles. grades to gray brown near base of spoon		HNu reading up to 150ppm; HNu reading up to 50ppm
	6.5–8		SB-06 -04	16"	5-13-15	6-8" dark gray brown silty clay w/gravel firm moist; 8-16" lighter color + less clay. some med to fine sand lenses		HNu readings up to 4ppm
	8–10		SB-06 -05	0"; 0"; 8" (3 trys for sample)	8-17-19	Fine to med. sand some fines wet. med. to gray-brown		HNu readings up to 5ppm
	10–11.5		SB-06 -06	8"	7-10-10	dark gray-brown silty clay w/ gravel Firm moist. some pockets of fine to med. sand.		HNu readings up to 5ppm
	12							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER
	SB-03 SHEET 1 OF

SOIL BORING LOG

PROJECT ECC LOCATION NW corner of Conc. Pad (≈27'E + 27'S)

ELEVATION ______ DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT ______

WATER LEVEL AND DATE ______ START 10-23-84, 7:00am FINISH ______ LOGGER BJB

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0–1					0-6" Conc. Pad. HNu Bkgd. 3ppm		HNu readings 40-50ppm in hole just below pad.
	1–2.5	X	SB-03-01	4"	8-7-6	Coarse Gravel Fill, med gray, some silty clay binder. Gravel up to 3" diam, moist, firm		HNu reading up to 50ppm
	2.5–4	X	SB-03-02 [CLP + ...]	18"	8-13-18	reddish brown gravelly silty clay, gray-brown mottles. bottom has distinct platy structure with reddish iron staining of fracture surfaces moist firm		Top - HNu up to 15ppm; Bottom HNu up to 6ppm
	4–5.5	X		0"	25-33-39	No recovery.		
	5.5–7	X	SB-03-03	11"	18-21-17	gravelly silty clay, dense, firm, reddish iron stains abundant on fracture surfaces 2" fine to med sand lense. (reddish brown) silty clay dark greenish gray. moist		nothing on HNu
	7–8.5	X	SB-03-04	16"	11-15-11	0-10" gray-brown coarse sand - fine gravel w/ fines. wet. 10-16" dense gray-brown silty clay w/ gravel no mottling		nothing on HNu
	8.5–10	X	[redacted]	0"	6-13-15	No recovery		
	10–11.5	X	SB-03-05	16"	6-9-15	Same as SB-03-04		HNu readings up to 8ppm
	12							

REV. 11/82 FORM D1586

CH2M HILL

PROJECT NUMBER	BORING NUMBER SB-08	SHEET OF

SOIL BORING LOG

PROJECT ECC LOCATION 60'W + 25'N of SE corner of Pad

ELEVATION ______ DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT Hollow Stem Auger

WATER LEVEL AND DATE ______ START 10-24-84 10:00 FINISH ______ LOGGER BJD

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0					0 – 0.6' Conc. Pad		HNu bkgd. 2-3 ppm
	1–2.5	X	SB-08 -01	10"	7-14-12	0-3 → black pea gravel 3-8 → gray coarse angular gravel w/ fines 8-10 → reddish brown silty clay / w/ gravel firm		HNu upto 120 ppm
	2.5–4	X	SB-08 -02 [CLP]	9"	9-7-12	reddish brown silty clay w/ gravel firm moist some gray-brown areas.		HNu upto 20 ppm
	4–5.5	X	SB-08 -03	18"	4-10-11	0-4 same as above 4-14 reddish brown silty clay w/ gravel and higher sand content in lenses 14-18 – gray brown silty clay w/ gravel platy structure w/ iron stains on fracture surfaces		HNu upto 20 ppm top of sample upto 5 ppm at bottom
	5.5–7	X	SB-08 -04	6"	7-8-10	same as above, except very few iron stains or zones of reddish brown		HNu 1 ppm above bkgd
	7–8.5	X	SB-08 -05 [CLP]	9"	5-7-10	dark gray brown silty clay w/ gravel some stringers of sand. firm moist		HNu 1 ppm above bkgd.
	8.5–10	X	SB-08 -06	12"	5-8-8	same as above		Nothing on HNu
	10–11.5	X	SB-08 -07	14"	6-9-8	gray brown silty sand – sandy silt no gravel. wet.		Nothing on HNu
	12							
								* water rises to top of hole.

CH2M HILL

PROJECT NUMBER	BORING NUMBER SB-05	SHEET 1 OF 1

SOIL BORING LOG

PROJECT ______ LOCATION Conc. Pad.

ELEVATION ______ DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT HSA's

WATER LEVEL AND DATE ______ START 1620 - 10/24/84 FINISH ______ LOGGER I. H. Johnson

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	SAMPLE RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
						0-0.7 ft. Concrete Pad		HNu Background ~2ppm
	1.5, 2, 2	X	SB-05-01	14"	8-10-13	Top 3" - Crushed Gravel Fill Silty Clay, Brown, Mottled, Hard, moist		HNu up to 15ppm
	3, 3, 4	X	02 CLP	9"	7-12-12	Silty Clay, as above		HNu up to 30ppm
	4, 5, 5	X	03	15"	5-10-15	Silty Clay / Clayey Silt, Gray, Hard, Moist		HNu up to 15ppm
	6, 6, 7	X	04 CLP	18"	13-16-19	Silt, Gray, Stiff to Hard, moist		HNu up to 5ppm
	7, 8, 8	X	05 CLP	18"	11-8-10	Silty Sand (Top 6"), GRAY, Fine, WET Clayey Silt, Gray, Moist		HNu up to 4ppm
	9, 9, 10	X	06	18"	6-8-10	Silty Clay, Gray (Dark), Moist, HARD		HNu up to 3ppm
	10, 11, 11, 12, 12	X	07	6"	4-4-9			HNu up to ~2ppm

REV 11/82 FORM D1586

CH2M HILL

PROJECT NO.	TEST PIT NO. AREA 9, TP 1 SHEET 1 OF

TEST PIT WALL LOG

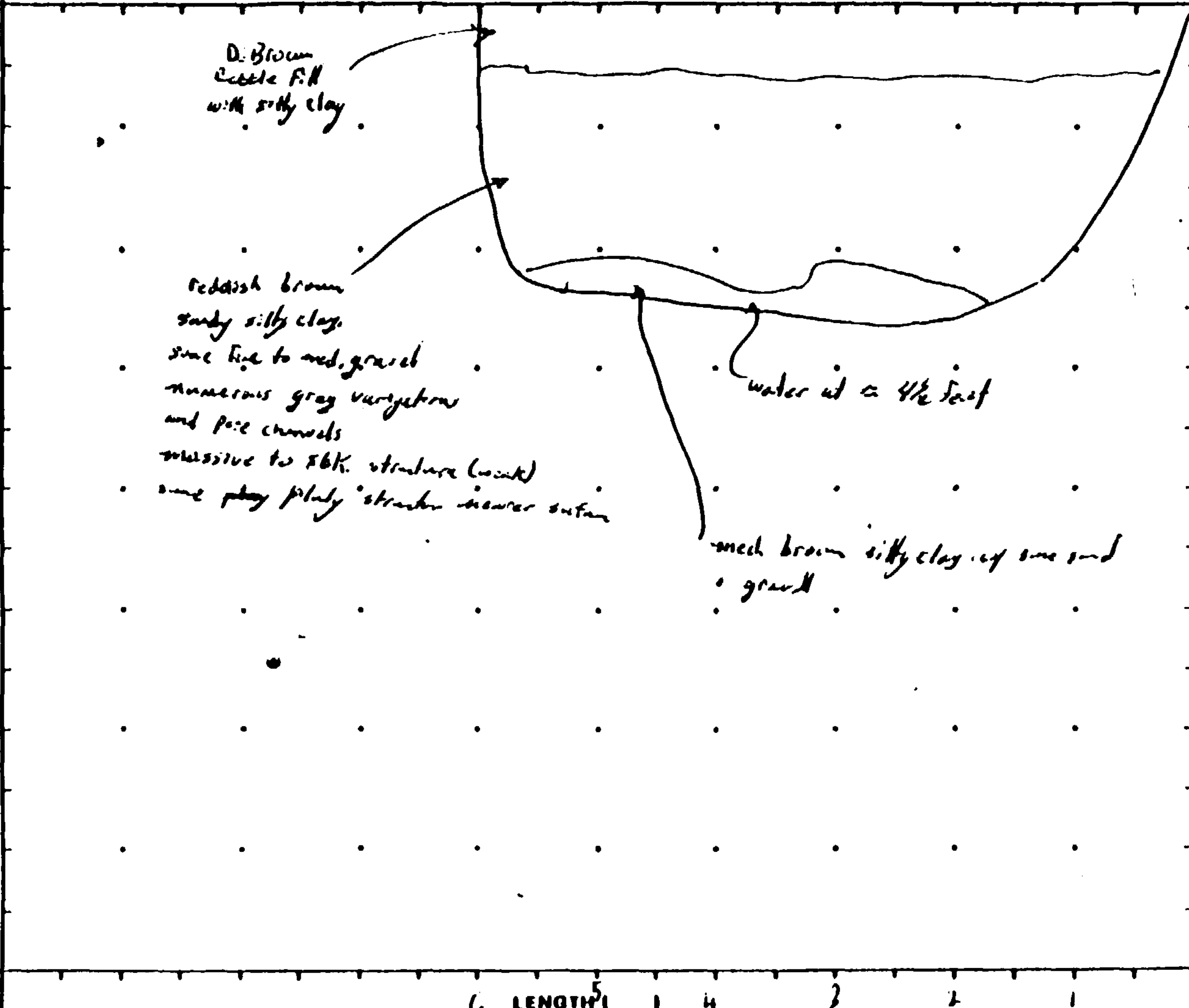
PROJECT ECC LOCATION AREA 9 (A-2) MAP OF NW WALL OF PIT

ELEVATION ______ CONTRACTOR ______ DATE EXCAVATED 10-22-84

WATER LEVEL AND DATE ______ EXCAVATION METHOD ______ LOGGER ______

APPROXIMATE DIMENSIONS: LENGTH ______ WIDTH ______ DEPTH ______ REMARKS ______

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER
	1		
	2		
	3		
	4		
	5		



COMMENTS

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
W65230.C3	SB-07	1 OF

SOIL BORING LOG

PROJECT ECC RI LOCATION Conc. Pad

ELEVATION DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT HSA

WATER LEVEL AND DATE START 10/24/84-1415 hrs FINISH 10/24-1600 hrs LOGGER J.H. Johnson

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
	0					0-0.7' Concrete Pad		HNu Background ~2 ppm
	1-2		SB-07-01	14"	14-19-17	Top 4" - Fill, Crushed Gravel; Bottom 10" - Clayey Silt, Brown Gray Mottled, Moist		HNu up to 20ppm
	3-4		SB-07-02	2"	7-9-12	As above		No Sample Collected
	4-5		SB-07-03	18"	8-11-10	Clayey Silt, Gray, Mottled Brown, Moist		HNu up to 4ppm CLP SAMPLE
	6-7		SB-07-04	18"	4-9-12	Clayey Silt, Gray, V. Stiff to Hard, Moist		HNu up to 4ppm
	7-8		SB-07-05	16"	11-15-18	Top 8" - Silt, Gray, Moist to wet; Bottom 8" - Silty Sand, Gray, Fine, wet		HNu up to 3ppm
	9-10		SB-07-06	14"	8-16-19	Silt, Gray, Moist		HNu ~2ppm CLP Sample
	10-11		SB-07-07	14"	11-17-18	Silt, Gray, Moist, Silty Sand near bottom of sample		HNu ~2ppm
	12							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NO.	TEST PIT NO. AREA 9 TP 3 SHEET 1 OF

TEST PIT WALL LOG

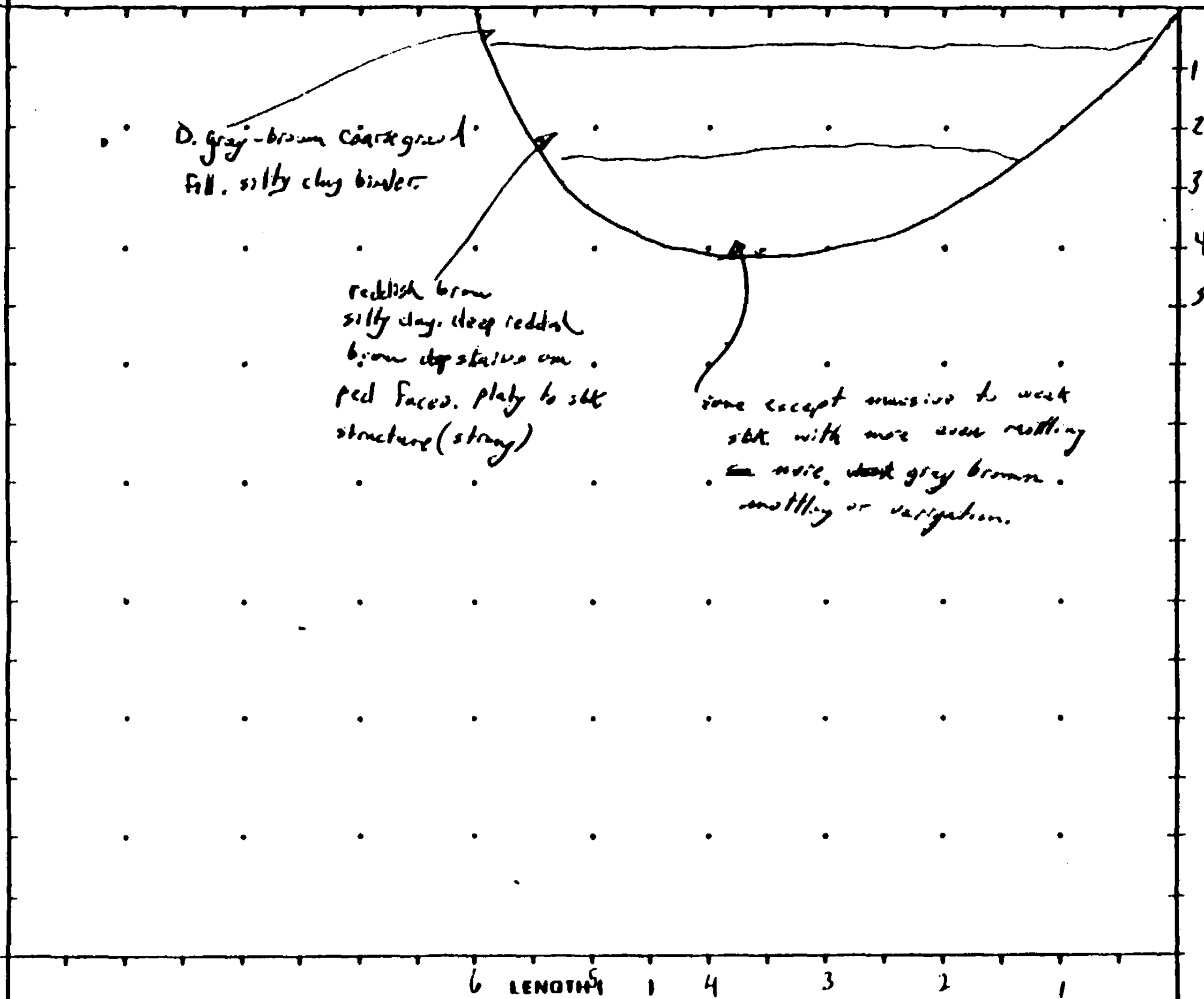
PROJECT ______ LOCATION ______ MAP OF E WALL OF PIT

ELEVATION ______ CONTRACTOR ______ DATE EXCAVATED ______

WATER LEVEL AND DATE ______ EXCAVATION METHOD ______ LOGGER BJD

APPROXIMATE DIMENSIONS: LENGTH ______ WIDTH ______ DEPTH ______ REMARKS ______

ELEVATION	DEPTH BELOW SURFACE ( )	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER



COMMENTS

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NUMBER	BORING NUMBER
	SB-09 SHEET 1 OF 1

SOIL BORING LOG

PROJECT ECC LOCATION ≈ 25'N + 25'E of SW corner of P30

ELEVATION DRILLING CONTRACTOR ATEC

DRILLING METHOD AND EQUIPMENT Hollow Stem Auger

WATER LEVEL AND DATE START 10-28-94 11:30 am FINISH LOGGER BTB

ELEVATION	DEPTH BELOW SURFACE	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER	SAMPLE: RECOVERY	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: NAME, GRADATION OR PLASTICITY, PARTICLE SIZE DISTRIBUTION, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY, USCS GROUP SYMBOL	SYMBOLIC LOG	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
						0 - 0.7' Conc. Pad		HNu bkgd 2-2.5 ppm
	1-2.5	X	SB-09-01	9"	9-21-16	0-2" Pea Gravel 2-9" Coarse Gravel Fill		HNu upto 250 ppm
	2.5-4	X	SB-09-02 (UP)	13"	15-12-10	reddish brown silty clay w/gravel Firm, moist.		HNu upto 40 ppm
	4-5.5	X	SB-09-03	16"	15-12-10	Same as above. Bottom 6" softer and appears to have more clay		HNu readings between 40 + 20 ppm
	5.5-7	X	SB-09-04 (UP)	18"	2-2-3	Same as bottom of above. Lower portion grades to gray brown with reddish mottles. wet		HNu upto 20 ppm
	7-8.5	X	SB-09-05	18"	4-7-11	med. brown silty clay w/gravel moist soft. reddish brown mottling.		HNu upto 9 ppm
	8.5-10	X	SB-09-06	18"	6-8-13	Same as above. Lower 10" is equally gray brown and reddish brown variegated.		HNu upto 5 ppm
	10-11.5	X	SB-09-07	13"	2-8-9	0-8 Same as above 8-13" gray brown silty clay w/gravel No mottling. (some wet.)		HNu upto 20 ppm
	12							

REV 11/82 FORM D1586

CH2M HILL

PROJECT NO.	TEST PIT NO. AREA 9, TP-6 SHEET 1 OF

TEST PIT WALL LOG

PROJECT ______ LOCATION ______ MAP OF W WALL OF PIT

ELEVATION ______ CONTRACTOR ______ DATE EXCAVATED ______

WATER LEVEL AND DATE ______ EXCAVATION METHOD ______ LOGGER BJB

APPROXIMATE DIMENSIONS: LENGTH ______ WIDTH ______ DEPTH ______ REMARKS ______

ELEVATION | DEPTH BELOW SURFACE | SAMPLE: INTERVAL | TYPE AND NUMBER | COMMENTS

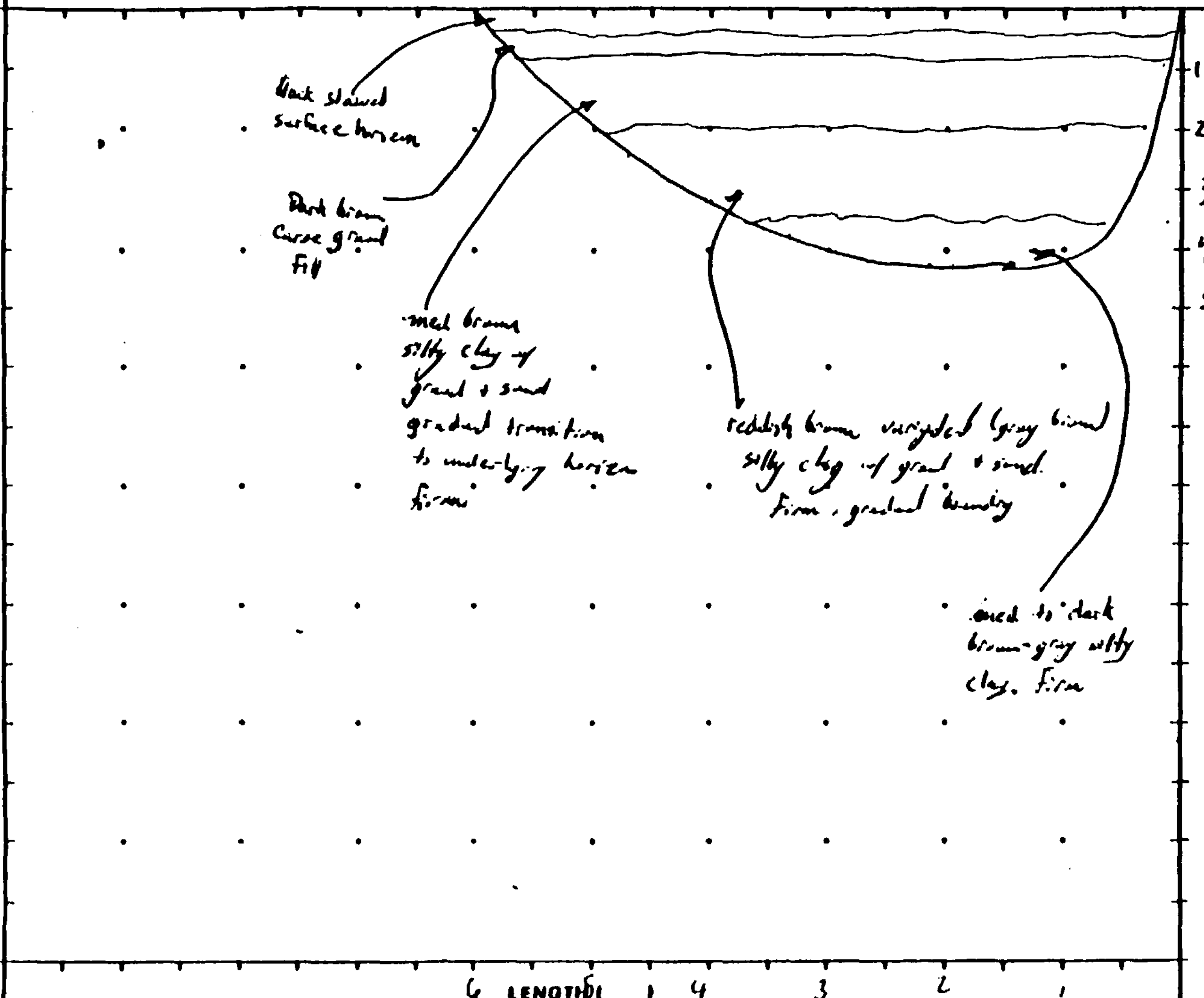


Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NO.	TEST PIT NO. TP2 (Area 4) SHEET OF

TEST PIT WALL LOG

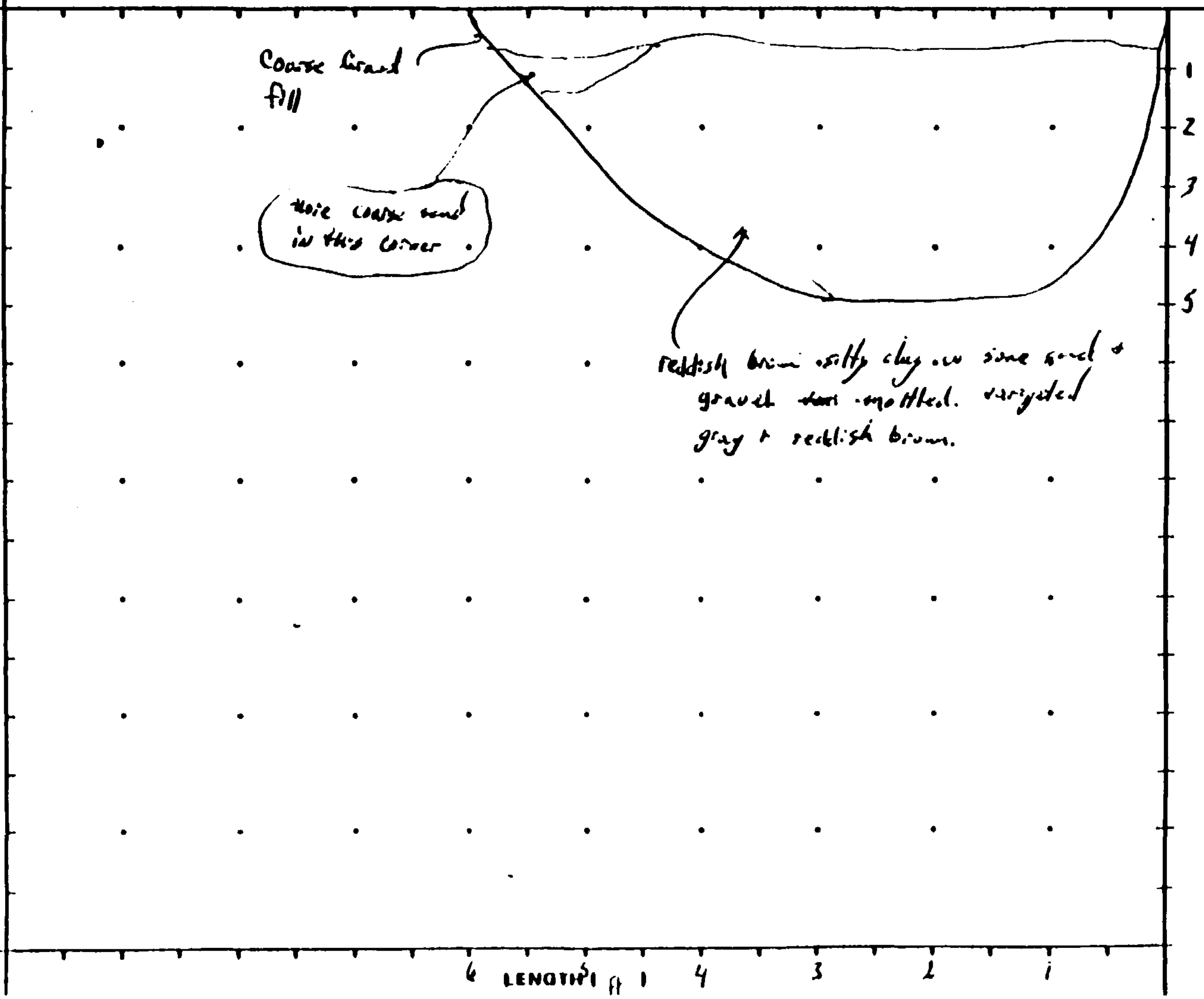
PROJECT ______ LOCATION ______ MAP OF W WALL OF PIT

ELEVATION ______ CONTRACTOR ______ DATE EXCAVATED ______

WATER LEVEL AND DATE ______ EXCAVATION METHOD ______ LOGGER BJB

APPROXIMATE DIMENSIONS: LENGTH ______ WIDTH ______ DEPTH ______ REMARKS ______

ELEVATION	DEPTH BELOW SURFACE ( )	SAMPLE: INTERVAL	SAMPLE: TYPE AND NUMBER



COMMENTS

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NO.	TEST PIT NO. 8 SHEET 1 OF 1

TEST PIT WALL LOG

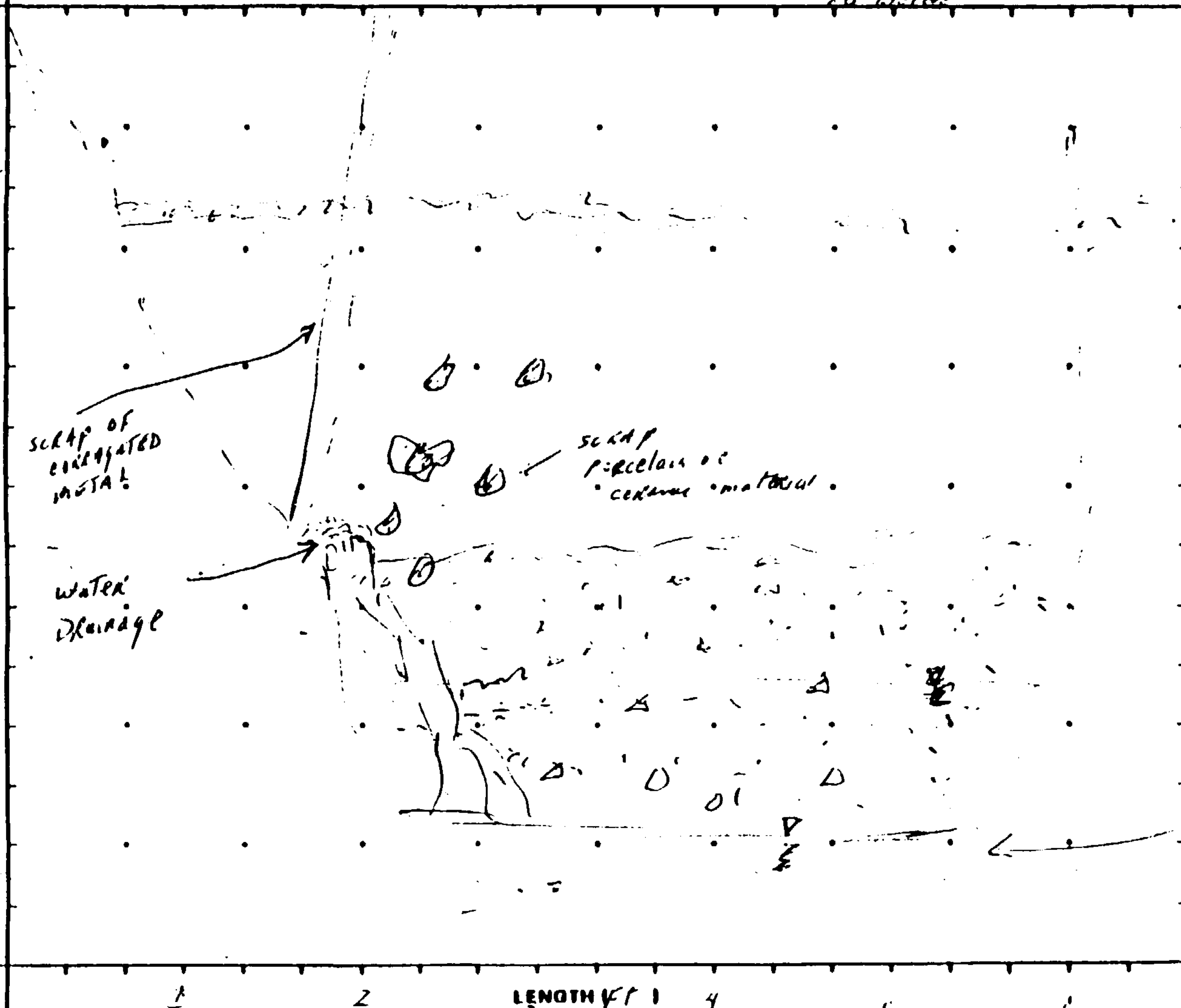
PROJECT ECC LOCATION MAP OF North WALL OF PIT

ELEVATION CONTRACTOR DATE EXCAVATED 10/24/84

WATER LEVEL AND DATE EXCAVATION METHOD Back Hoe LOGGER RJS

APPROXIMATE DIMENSIONS: LENGTH 6' WIDTH 4' DEPTH 4'-8" to water REMARKS

ELEVATION	DEPTH BELOW SURFACE ( )	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER
			1 VOA
	1		3 VOA 2 CLP
	2		
			3 VOA 2 CLP
	3		
	4		VOA
	5		



COMMENTS

Clay material (brown)

1' Black Band of clay material

2' clay material (brownish-gray)

3' Gravel Layer

Water Table

4'

5'

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NO.	TEST PIT NO. AREA 9, TP 4 SHEET OF

TEST PIT WALL LOG

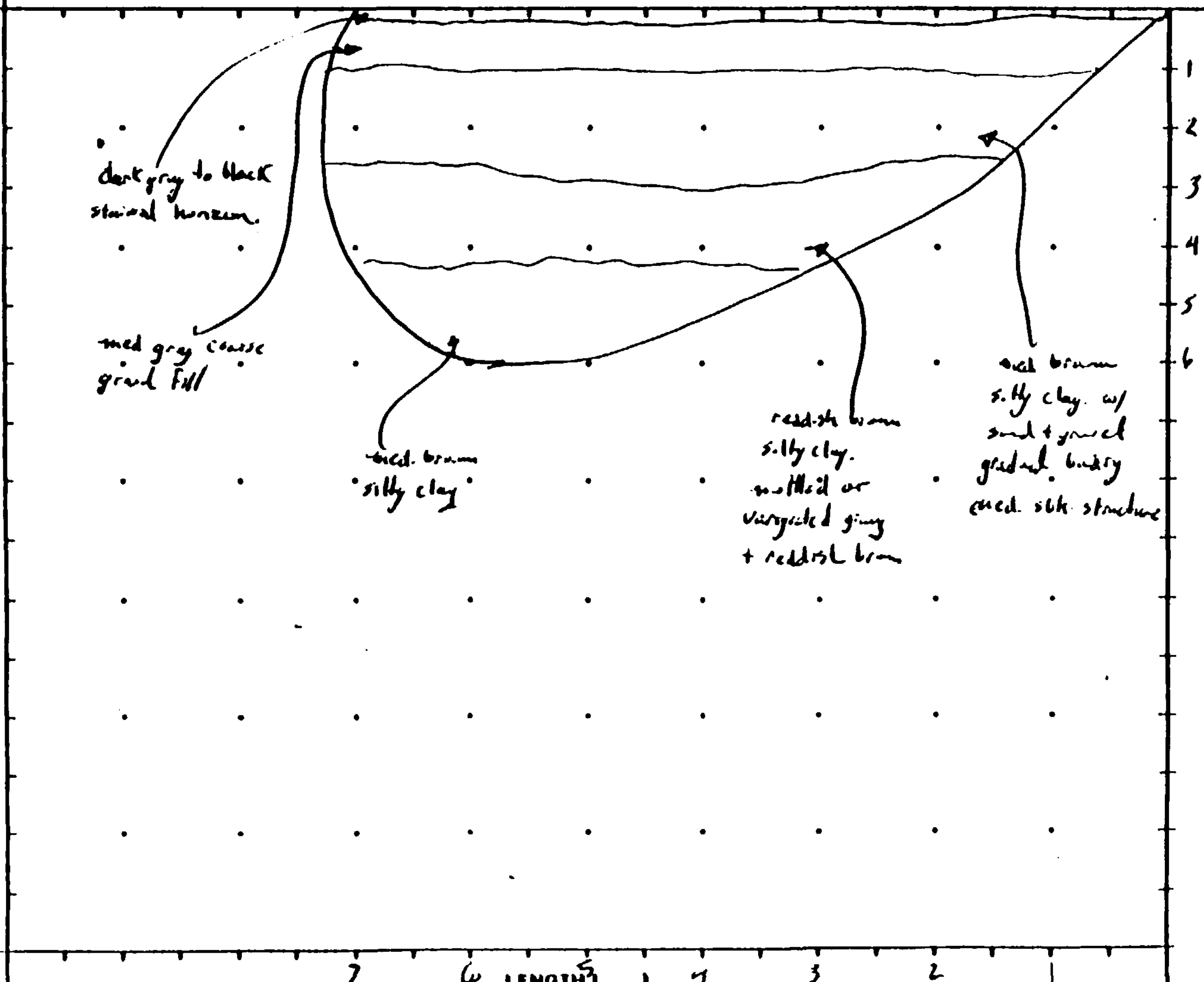
PROJECT ______ LOCATION ______ MAP OF E WALL OF PIT

ELEVATION ______ CONTRACTOR ______ DATE EXCAVATED ______

WATER LEVEL AND DATE ______ EXCAVATION METHOD ______ LOGGER BJB

APPROXIMATE DIMENSIONS: LENGTH ______ WIDTH ______ DEPTH ______ REMARKS ______

ELEVATION	DEPTH BELOW SURFACE ( )	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER



COMMENTS

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NO.	TEST PIT NO. 1 SHEET OF 1

TEST PIT WALL LOG

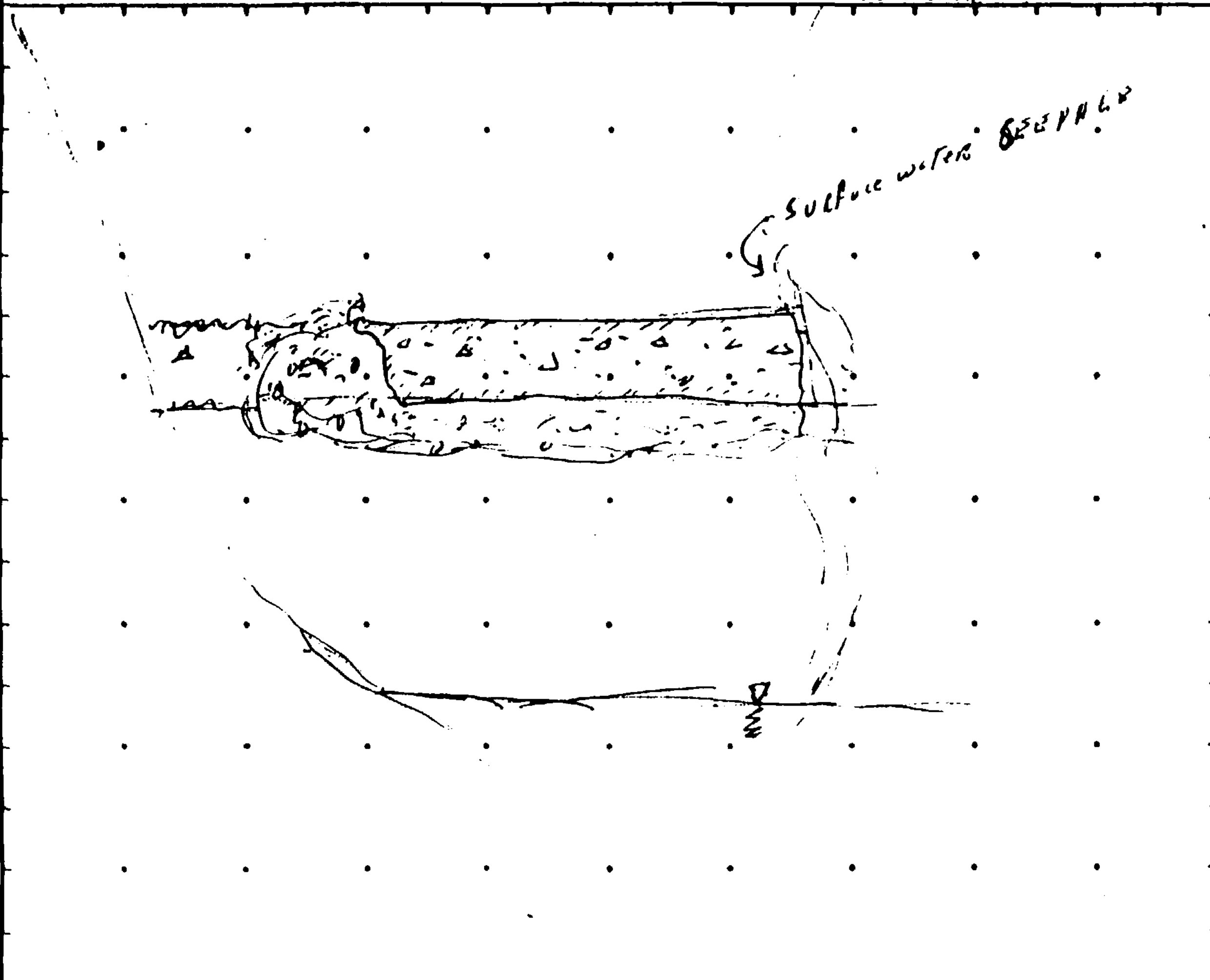
PROJECT ECC LOCATION MAP OF SW WALL OF PIT

ELEVATION CONTRACTOR DATE EXCAVATED 10/27/84

WATER LEVEL AND DATE EXCAVATION METHOD BACK HOE LOGGER RJ

APPROXIMATE DIMENSIONS: LENGTH 7' WIDTH 3.5' DEPTH 5' 5" TO WATER REMARKS

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER
	1		1 VOA
	2		3 VOA 2 CLP
	3		4 VOA 2 CLP
	4		
	5		Soil
	6		



LENGTH (ft) 1 2 3 4 5 6 7 8

COMMENTS

1–2 Brownish clay material

3 Asphalt concrete pad

4 gravel layer

5 Brownish gray clay material

6 water ~~table~~ Level

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NO.	TEST PIT NO. AREA 9, TP6 SHEET 1 OF

TEST PIT WALL LOG

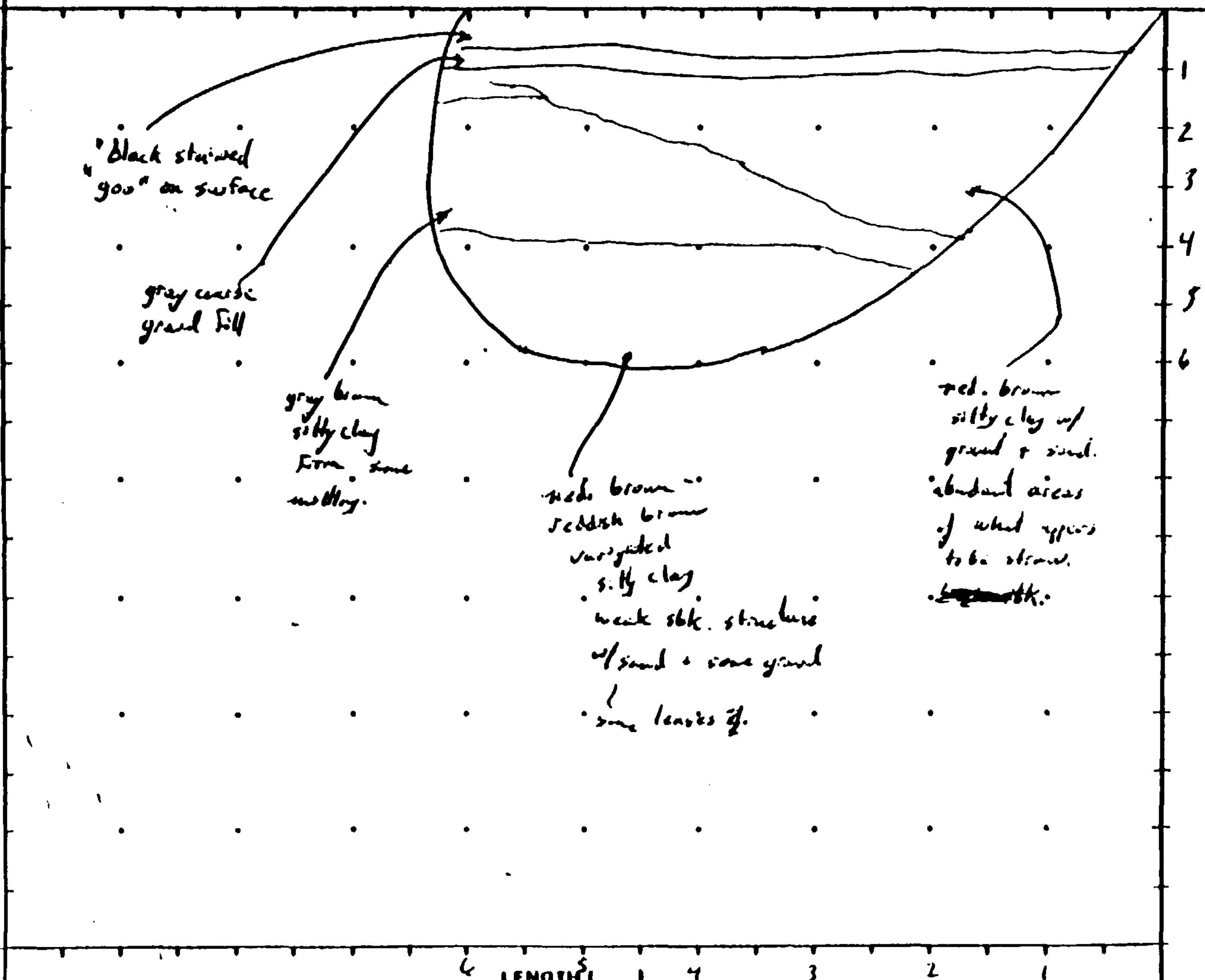
PROJECT ______ LOCATION ______ MAP OF E WALL OF PIT

ELEVATION ______ CONTRACTOR ______ DATE EXCAVATED ______

WATER LEVEL AND DATE ______ EXCAVATION METHOD ______ LOGGER ______

APPROXIMATE DIMENSIONS: LENGTH ______ WIDTH ______ DEPTH ______ REMARKS ______

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER



COMMENTS

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NO.	TEST PIT NO. 12 SHEET 1 OF

TEST PIT WALL LOG

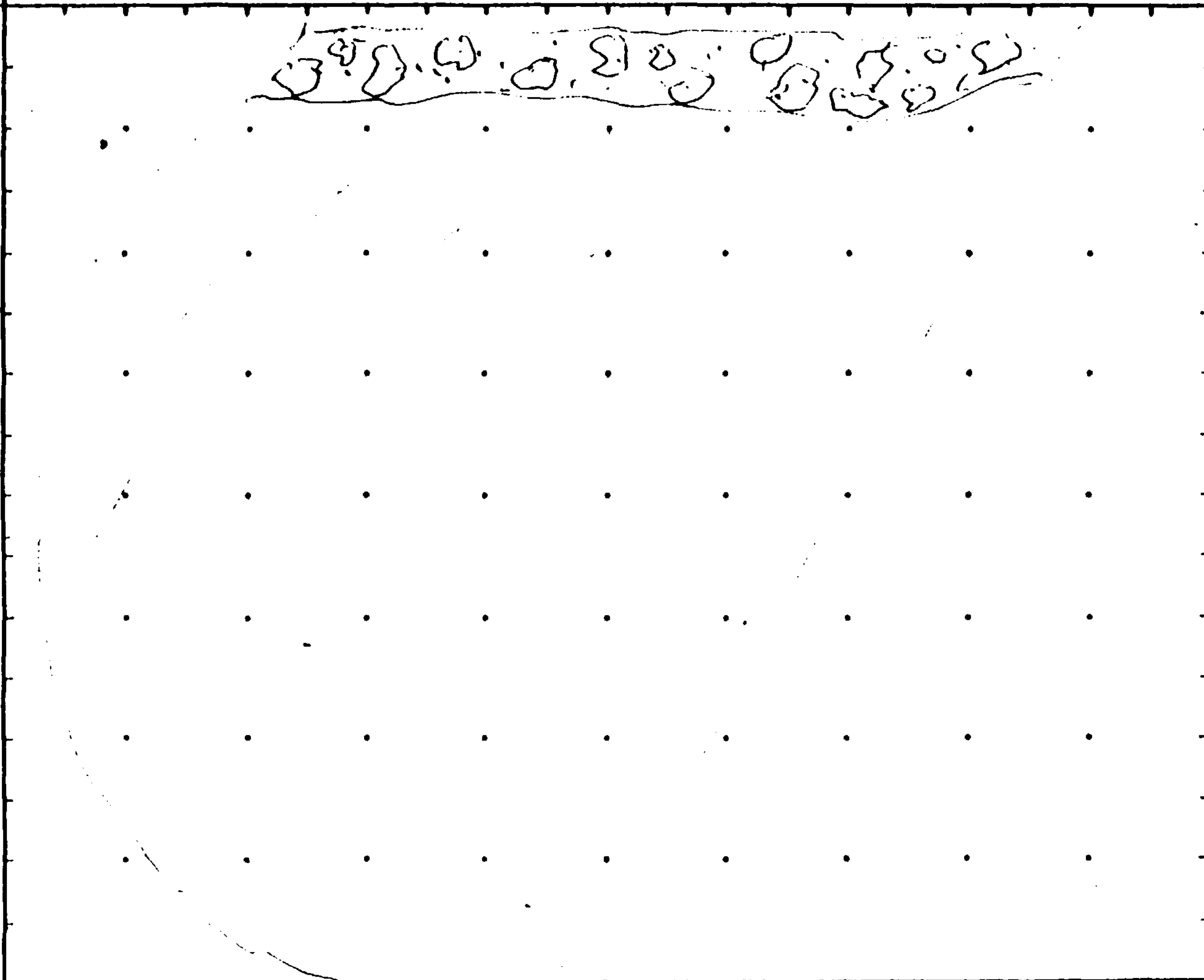
PROJECT ECC LOCATION MAP OF NE WALL OF PIT

ELEVATION CONTRACTOR DATE EXCAVATED 10/24/84

WATER LEVEL AND DATE EXCAVATION METHOD BACKHOE LOGGER RJS

APPROXIMATE DIMENSIONS: LENGTH 6' WIDTH 3.5' DEPTH 5.5' REMARKS

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER
			1 VOA
	1		3 VOA 7 CLP
	2		
	3		3 VOA 7 CLP
	4		
	5		1 VOA



LENGTH ( ) 1 2 4 5 6

COMMENTS

Coarse Gravel

1

Brown Sandy clay

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NO.	TEST PIT NO. 9 SHEET 1 OF 1

TEST PIT WALL LOG

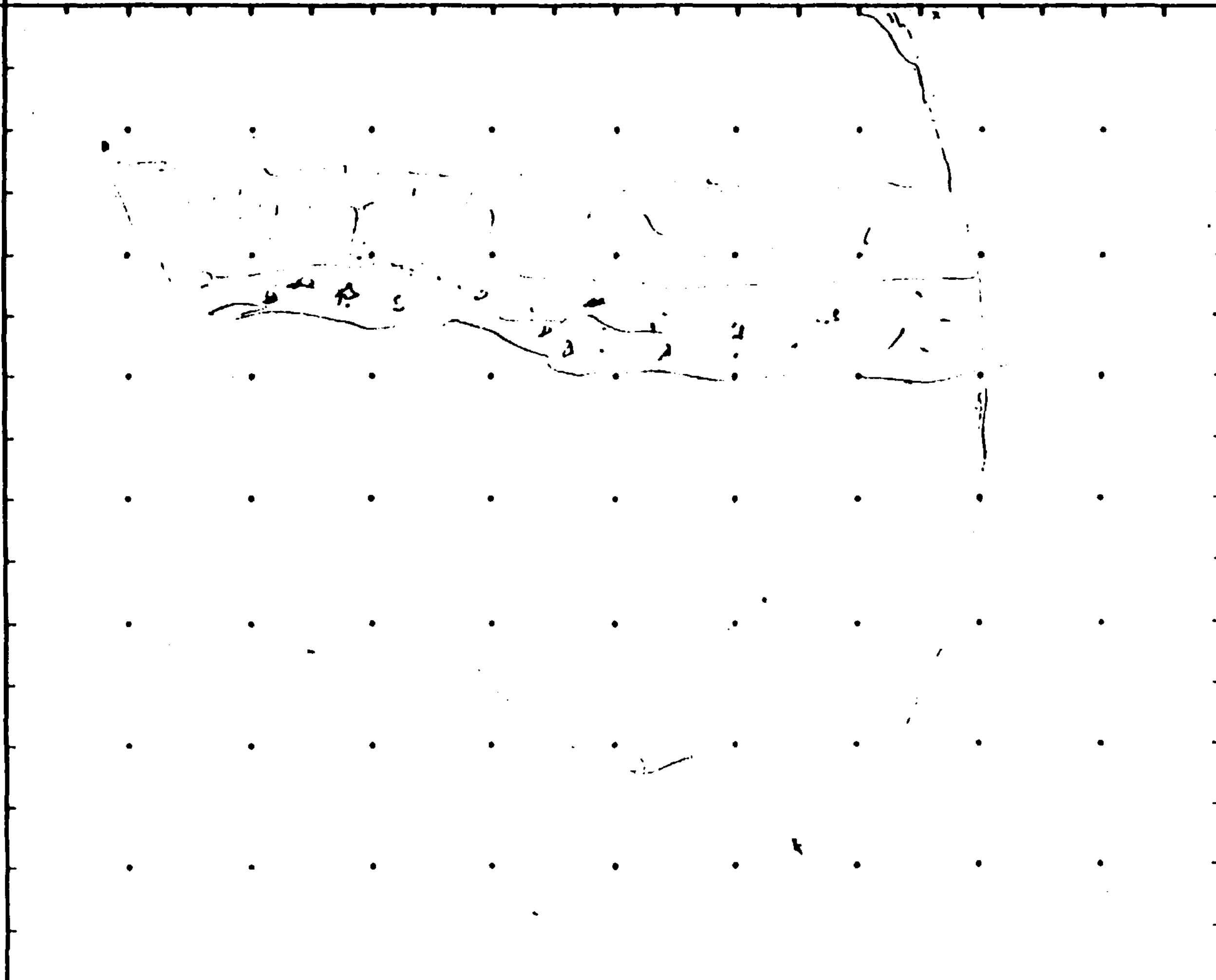
PROJECT ECC LOCATION ______ MAP OF East WALL OF PIT

ELEVATION ______ CONTRACTOR ______ DATE EXCAVATED 10/24/84

WATER LEVEL AND DATE ______ EXCAVATION METHOD Back Hoe LOGGER RJS

APPROXIMATE DIMENSIONS: LENGTH 8' WIDTH 3' DEPTH 6'-2" REMARKS ______

ELEVATION	DEPTH BELOW SURFACE	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER
			1 VOA
	1		3 VOA 2CLP
	2		
	3		3 VOA 2CLP
	4		
	5		1 VOA
	6		



LENGTH (FT) 1 2 3 4 5 6 7 8

COMMENTS

Brownish gray silty fine material (sand/clay)

1

Black Band of material

2

gravel Layer

3

4

Brown clay material

5

6

Figure 2
TEST PIT WALL LOG

CH2M HILL

PROJECT NO.	TEST PIT NO. 11 SHEET 1 OF

TEST PIT WALL LOG

PROJECT ECC LOCATION MAP OF NE WALL OF PIT

ELEVATION CONTRACTOR DATE EXCAVATED 10/24/84

WATER LEVEL AND DATE EXCAVATION METHOD BACKHOE LOGGER RJS

APPROXIMATE DIMENSIONS: LENGTH 8' WIDTH 3' DEPTH 5.5' REMARKS

ELEVATION	DEPTH BELOW SURFACE (FT)	SAMPLE INTERVAL	SAMPLE TYPE AND NUMBER	COMMENTS
			1 VOA	COARSE GRAVEL 2" to 3" diameter
	1		3 VOA 2 CLP	Brown clay & sand
	2			
	3		3 VOA 2 CLP	
	4			
	5		1 VOA	
	6			
	7			

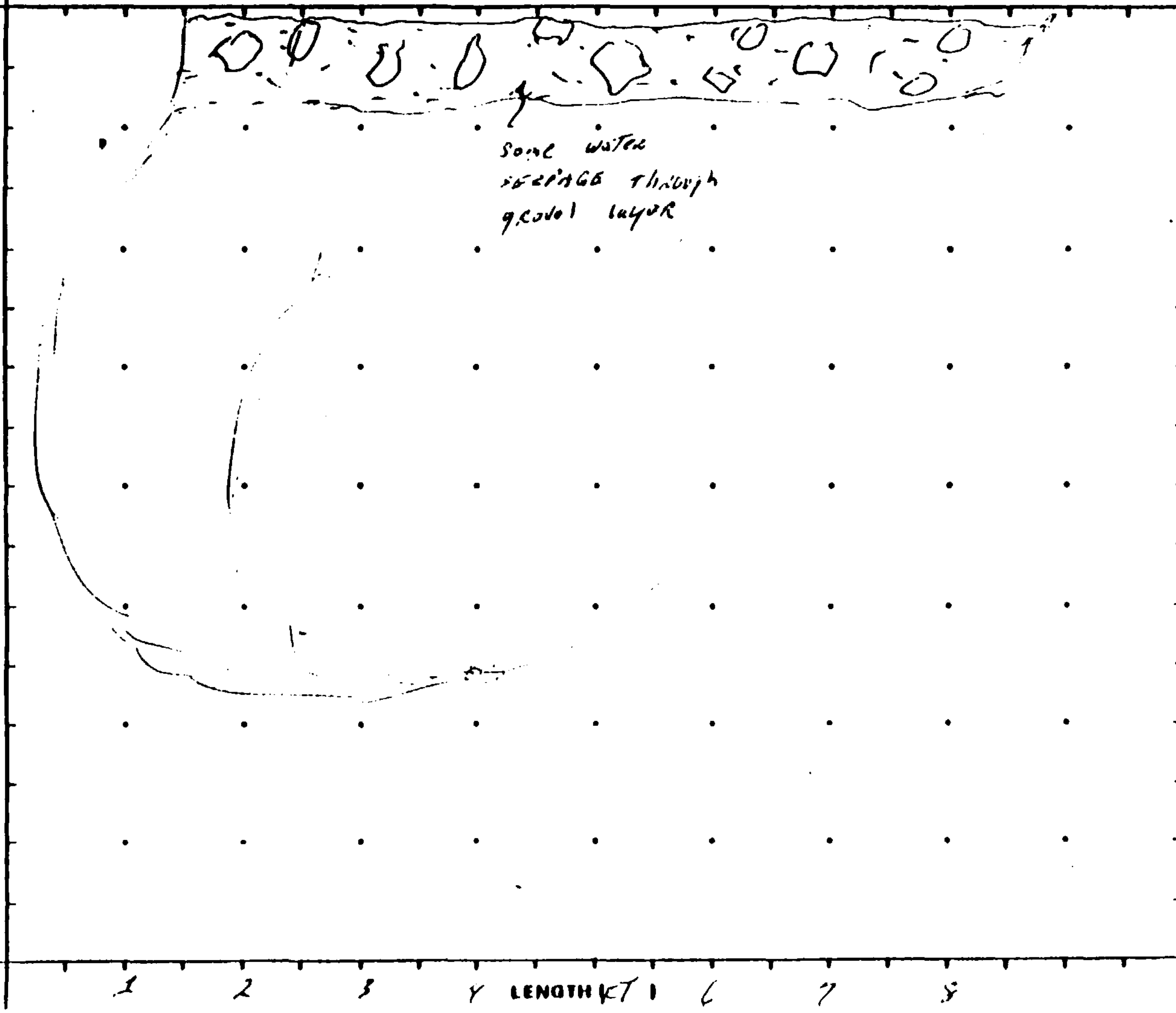


Figure 2
TEST PIT WALL LOG

Appendix B
AERIAL PHOTOGRAPHS AND TOPOGRAPHIC MAP

(Not included with this copy. Contact U.S. EPA Region V for Aerial Photographs and Topographic Map)

Appendix C
CONTAMINANT TRANSPORT AND FATE

ECC SITE

RI REPORT, VOL. 2

MARCH, 1986

Appendix C
CONTAMINANT TRANSPORT AND FATE

Appendix C-1

SAMPLE CALCULATION

The following is a sample calculation of the transport and fate of trichloroethene.

Physical-Chemical Properties

Solubility = 1,100,000 ug/l
Partition Coefficient (K_d) = 0.24

Site Characteristics

Soil concentration = 96 mg/kg average
4 mg/kg acceptable level
Hydraulic Conductivity (in saturated zone) = 10^{-5} cm/s = 10.3 ft/yr
Porosity (n) = 0.10
Bulk density (P) = 1,800 kg/m^3
Recharge(r) = 7.8 inches/yr = 0.2 m/yr
Gradient (I) = 0.02 feet/foot
Retardation coefficient (R) = 1 + $\left(\frac{P}{n}\right)(k_d)$ = 3.2

Determine Concentration in Leachate

Assume 1 square meter; volume of water = (0.2 m/yr)(1 m^2) = 0.2 m^3/yr = 200 liters/yr

Using 1 meter depth; weight of soil = (1,800 kg/m^3) (1 m^3) = 1,800 kg of soil

Contaminant Depletion:

- Mass of TCE in soil = (96 mg/kg) (1,800 kg) = 172,800 mg TCE

- Assume the following isotherm $C_s = K_d C_w$; where C_s = concentration in soil and C_w = concentration in leachate

  $$C_w = \frac{96\ mg/kg}{0.24} = 400\ mg/kg = 400\ mg/l = 400{,}000\ ug/l$$

- Check to see if $C_w \le$ solubility

  C_w = 400,000 ug/l $\le$ solubility (1,100,000 ug/l)

  therefore, C_w = 400,000 ug/l

$Kd = \frac{Cs}{Cw}$

Determine Dilution of Leachate in the Groundwater of the Saturated Zone

Groundwater flow velocity (V_{gw}) = $\frac{KI}{n}$ =

$$\frac{(10.3\ ft/yr)(0.02\ ft/ft)}{0.10} = 2.1\ ft/yr = 0.64\ m/yr$$

Volume of Groundwater (Q_{gw}) = KIA

Assume groundwater flows through area 4 meters deep and 1 meter wide;

$$A = 4m^2 = 40,000\ cm^2$$

$$Q = KIA = (10^{-5} cm/s)(0.02\ ft/ft)(40,000\ cm^2)$$

$$(31,500\ \frac{1\ s_3}{yr\ cm}) = 252\ liters/yr$$

Volume of Leachate (Q_w) = (r)(area)($_{gw}$) =

$$(\frac{200\ L/yr}{m})(1m)(0.64\ m) = 128\ liters/yr$$

$$\text{Dilution of Leachate} = \frac{Q_w}{(Q_{gw})} = \frac{128\ L/yr}{(252\ L/yr)} = 0.51$$

Determine Groundwater Concentration

C_{gw} = 0.51 C_w = 0.51 (400,000 ug/l) = 200,000 ug/l

Determine Travel Time to Surface Water

Distance to unnamed ditch = 200 ft
Distance to Finley Creek = 500 ft

Travel Time (tt) = (distance)/(V_{gw}/R)

$$tt = \frac{(200\ ft)}{(2.1\ ft/yr)/(3.2)} = \underline{300\ years\ to\ ditch}$$

$$tt = \frac{(500\ ft)}{(2.1\ ft/yr)/(3.2)} = \underline{760\ years\ to\ Finley\ Creek}$$

Determine Concentration in Surface Water

Volume of groundwater discharge assuming a 1 meter width is Q_{gw} = 252 L/yr. Discharge actually occurs along a width of 280 m; therefore,

Q_{gw} = (252 L/yr/m)(10^{-3} m^3/l)(200 m) = 50.5 m^3/yr = 5.6 x 10^{-5} ft^3/sec

Surface Water Flow:

- o Unnamed ditch = 0.1 cfs
- o Finley Creek = 0.1 to 1 cfs

Dilution = $\frac{5.6 \times 10^{-5}}{0.1}$ to $\frac{5.6 \times 10^{-5}}{1.0}$ = 1:1,800 to 1:18,000

Surface Water Concentration (C_{sw}) = (C_{gw}) (Dilution)

- o Unnamed ditch, C_{sw} = (200,000 ug/l)(1/1,800) = 110 ug/l

- o Finley Creek, C_{sw} = (200,000 ug/l)(1/1,800) = 110 ug/l

- o Finley Creek, C_{sw} = (200,000 ug/l)(1/18,000) = 11 ug/l

GLT533/7

Appendix C-2
ENVIRONMENTAL PROFILES OF CONTAMINANTS

1,1,1-TRICHLOROETHANE

The behavior of 1,1,1-trichloroethane is largely controlled by its high vapor pressure. 1,1,1-trichloroethane will not persist in surface soils and aquatic systems because of its tendency to volatilize. Callahan et al. (1979) give an aquatic volatilization half-life on the order of several minutes to a few hours, depending upon the degree of agitation. Once in the atmosphere, 1,1,1-trichloroethane will tend to slowly degrade via photo-oxidation, with a reported half-life ranging from 1.1 to 8 years (Callahan et al., 1979).

Oxidation and hydrolysis of 1,1,1-trichloroethane in soils and aquatic systems proceed at rates that are slow relative to volatilization. The maximum reported half-life for hydrolysis is 6 months; the half-life for oxidation is unknown, but is reported to be very slow (Callahan et al., 1979). Thus, these fate mechanisms are insignificant in aquatic systems. Photodissociation in water or air is not expected to occur (Jaffe and Orchin, 1962).

Based on its octanol-water partition coefficient, sorption of 1,1,1-trichloroethane is expected to be limited. Dawson et al. (1980) state that sorption of 1,1,1-trichloroethane will be proportional to the organic content of soils and surface area of clays. Thus, its mobility in aquatic systems will be controlled mainly by the rate of water movement rather than sediment movement.

The persistence of 1,1,1-trichloroethane in subsurface soils and groundwater will be controlled by hydrolysis. Biodegradation has been found to occur, but usually under anaerobic conditions as a result of reductive dehalogenation (Bouwer and McCarty, 1983). Thus, biodegradation will not be important in aerated subsurface soils and groundwater. The rate of biodegradation is difficult to estimate on a site-specific basis.

The mobility of 1,1,1,-trichloroethane in subsurface soils and groundwater will be high because it has little tendency for sorption.

TETRACHLOROETHENE

The behavior of tetrachloroethene is largely controlled by its vapor pressure. Tetrachloroethene will not persist in surface soils and aquatic systems because of its tendency to volatilize. The volatilization half-life for tetrachloroethene in water is on the order of several minutes to a few hours, depending upon the degree of agitation (Callahan et al., 1979). In the atmosphere, tetrachloroethene has a half-life of about 10 days (Callahan et al., 1979). Its degradation in air is a result of photo-oxidation forming trichloroacetylchloride and some phosgene.

While tetrachloroethene will degrade via photo-oxidation in surface soils and aquatic systems, the rate of degradation is slow relative to its rate of volatilization. Callahan et al. (1979) give a maximum oxidation half-life of 8.8 months. The relative contribution of hydrolysis is unclear given the available data. It is expected to be insignificant in surface soils and aquatic systems, as is photodecomposition.

Sorption of tetrachloroethene will be limited as evidenced by its octanol-water partition coefficient. Sorption will largely be controlled by the organic matter content of soils or sediments. Thus, its mobility in aquatic systems will be controlled by water (rather than sediment) movement.

The persistence of tetrachloroethene in subsurface soils and groundwater will be controlled by the degree of aeration. Under anaerobic conditions, tetrachloroethene will be highly persistent, unless biodegradation occurs. Biodegradation of tetrachloroethene is possible under anaerobic conditions as a result of reductive dehalogenation (Bouwer and McCarty, 1983). It has been demonstrated that tetrachloroethene degrades to form trichloroethene (Bouwer and McCarty, 1983). Rates of biodegradation are difficult to estimate on a site-specific basis. Under aerobic conditions, tetrachloroethene may degrade as a result of oxidation.

The mobility of tetrachloroethene in subsurface soils and groundwater will be high because of its limited tendency for sorption.

TRICHLOROETHENE

The behavior of trichloroethene is largely controlled by its vapor pressure. Trichloroethene will not persist in surface soils and aquatic systems because of its tendency to volatilize. Its reported volatilization half-life from water is on the order of several minutes to a few days, depending upon the degree of agitation (Callahan et al., 1979). Once in the atmosphere, trichloroethene rapidly degrades via a photo-oxidation reaction that produces dichloroacetyl-chloride and phosgene. Callahan et al. (1979) give a 4-day half-life for this reaction.

While trichloroethene will degrade via photo-oxidation in surface soils and aquatic systems, the rate of degradation is slow relative to volatilization. Callahan et al. (1979) give a maximum oxidation half-life of 10.7 months. The relative contribution of hydrolysis is unclear given the available data. It is expected to be insignificant in surface soils and aquatic systems, as is photodecomposition.

Sorption of trichloroethene will be limited due to its low octanol-water partition coefficient. Organic content will tend to control the extent of sorption. When the organic content is small compared to the clay content (less than 1 to 5), the inorganic fraction will control trichloroethene sorption (Richter, 1981). Its mobility in aquatic systems will be controlled by water (rather than sediment) movement.

The persistence of trichloroethene in subsurface soils and groundwater will be controlled by the degree of aeration. Biodegradation can occur under anaerobic conditions as a result of reductive dehalogenation (Bouwer and McCarty, 1983). Rates of biodegradation are difficult to estimate on a site-specific basis. Under aerobic conditions, trichloroethene may degrade as a result of oxidation.

The mobility of trichloroethene in subsurface soils and groundwater will be high because of its limited tendency for sorption.

TOLUENE

The behavior of toluene is controlled by its vapor pressure. Toluene will not persist in surface soils or aquatic systems because of its tendency to volatilize. Its estimated half-life in water is on the order of a few hours (Callahan et al., 1979). Photo-oxidation of toluene in the atmosphere is rapid, with a half-life of about 15 hours (Callahan et al., 1979); this value is inferred based on the relative reactivity of toluene and reported conversion rates for m-xylene and 1,3,5-trimethylbenzene. Benzaldehyde is the major photo-oxidation byproduct for toluene (Laity et al., 1973).

While oxidation and photodecomposition are possible in water, the rates of degradation are probably slow relative to volatilization (Callahan et al., 1979). No rate data are available for either process. Hydrolysis is not expected to occur, according to Callahan et al. (1979). Thus, the persistence of toluene in surface soils and aquatic systems is largely controlled by volatilization.

Sorption of toluene will tend to be limited given its low octanol-water partition coefficient. Its mobility in aquatic systems will be controlled by water (rather than sediment) movement.

Toluene persistence in subsurface soils and groundwater will be high due to the insignificance of hydrolysis as a degradation mechanism. In addition, oxidation appears to occur only in the presence of sunlight. Biodegradation is possible given appropriate acclimation of soil bacteria and aerobic conditions (Callahan et al., 1979; Dawson et al., 1980). Rates of biodegradation are difficult to estimate on a site-specific basis.

The mobility of toluene in subsurface soils and groundwater will be high. Sorption is directly related to organic matter content (Callahan et al., 1979). Given its density ($0.866\ g/cm^3$), toluene could float on water if present in the pure form (Dawson et al., 1980).

CHLOROFORM

The behavior of chloroform or trichloromethane will be controlled by its vapor pressure. Chloroform will not persist in surface soils or aquatic systems because of its tendency to volatilize. Callahan et al. (1979) give a volatilization half-life in water on the order of several minutes to a few hours depending upon the degree of agitation. In the atmosphere, chloroform degrades rapidly as a result of photo-oxidation by hydroxyl radical attack producing phosgene and chlorine oxide. Callahan et al. (1979) give a photo-oxidation half-life on the order of several months.

While hydrolysis of chloroform in water is possible, the rate of degradation is slow relative to volatilization. Callahan et al. (1979) present a minimum half-life of 15 months based on experimental work by Dilling et al. (1979). A maximum half-life of 3,500 years is also given based on an extrapolation made by Radding et al. (1977). Dawson et al. (1980) give a hydrolysis half-life of 18 months. Oxidation and photodecomposition are not significant, if they occur at all.

Sorption of chloroform will be limited given its octanol-water partition coefficient. The extent of sorption is controlled by the organic matter content and surface area of clays (Dawson et al., 1980). Chloroform mobility in aquatic systems will be controlled by water (rather than sediment) movement.

There is some uncertainty as to how persistent chloroform is in subsurface soils and groundwater. While hydrolysis can occur, it is difficult to estimate a rate of degradation. Given appropriate acclimation, biodegradation of chloroform is possible under anaerobic conditions (Bouwer and McCarty, 1983).

The mobility of chloroform in subsurface soils and groundwater will be high.

POLYCHLORINATED BIPHENYLS

Polychlorinated biphenyls (PCB's) are a family of compounds whose environmental behavior can vary widely depending upon the degree of chlorination. In general, as the degree of chlorination increases so does the persistence and affinity for sorption; volatility and solubility decrease with degree of chlorination.

The mobility of PCB's is largely controlled by their high affinity for sorption and, to some extent, by their limited solubility in water. PCB sorption is a function of organic matter content and clay content, the former being the more important (Griffin and Chian, 1980). The mobility of PCB's in aquatic systems is controlled by sediment transport processes. Areas of high sediment deposition can become sinks of PCB and later sources as the PCB redissolves into the water column. PCB mobility in subsurface soils and groundwater is limited by sorption. However, under conditions where PCB is present in excess of its solubility, there is the potential for migration as a separate phase. Roberts *et al.* (1982) found that the migration of PCB as a separate phase in soil and groundwater explained why contamination at a spill site was more widespread than would be expected given its affinity for sorption.

Despite their relatively low vapor pressure and molecular weight, PCB volatilization from water and soil can occur. Adsorption dramatically reduces the rate of volatilization, however. Pal *et al.* (1980) has summarized volatilization half-lives for PCB's in water and soils. They range from tens to hundreds of days depending upon the type of PCB mixture and environmental conditions. Volatilization is an important mechanism because of the lack of other mechanisms that act to degrade PCB's.

The only important degradation process is biodegradation. However, it is only significant for the mono-, di-, and trichlorinated biphenyls. Biphenyls with five or more chlorines are essentially unaffected, while tetrachlorobiphenyls are moderately susceptible (Callahan *et al.*, 1979). Leifer *et al.* (1983) state that there is no evidence for PCB biodegradation under anaerobic conditions, but that numerous aerobic microorganisms are capable of degrading PCB's. Table 1 gives estimates for biodegradation half-lives in different media.

Table 1
HALF-LIVES OF PCB'S RESULTING FROM BIODEGRADATION
(Source: Leifer *et al.*, 1984)

	Mono- & Dichloro	Trichloro	Tetrachloro	Pentachloro and Higher
Aerobic				
Surface Waters				
Fresh	2-4 days	5-40 days	1 wk-2+ mos.	>1 year
Oceanic	-------several months------		-------->1 year---------	
Activated Sludge	1-2 days	2-3 days	3-5 days	*
Soil	6-10 days	------12-30 days-----		>1 year
Anaerobic	---------------------- ∞ -------------------------			

*It is not clear how long the highly chlorinated PCB's would last under activated sludge treatment but there appears to be no significant biodegradation during typical residence times.

More highly chlorinated PCB's in solution have been observed to break down through photolysis. Sufficient data are not available to estimate photolysis half-lives for environmental conditions (Leifer *et al.*, 1983). PCB's are resistant to both oxidation and hydrolysis (Callahan *et al.*, 1979; Leifer *et al.*, 1983).

1,1,2-TRICHLOROETHANE

The behavior of 1,1,2-trichloroethane is largely controlled by its high vapor pressure. 1,1,2-trichloroethane will not persist in surface soils and aquatic systems because of its tendency to volatilize. Callahan *et al.* (1979) give an aquatic volatilization half-life on the order of several minutes to a few hours, depending upon the degree of agitation. Once in the atmosphere, 1,1,2-trichloroethane will tend to slowly degrade via photo-oxidation, with a reported half-life ranging from 0.5 to 3 years (Callahan *et al.*, 1979).

Oxidation and hydrolysis of 1,1,2-trichloroethane in soils and aquatic systems proceed at rates that are slow relative to volatilization. The half-life for hydrolysis is estimated to be about 6 months; the half-life for oxidation is unknown, but is reported to be very slow (Callahan *et al.*, 1979). Thus, these fate mechanisms are insignificant in aquatic systems. Photodissociation in water or air is not expected to occur (Jaffe and Orchin, 1962).

Based on its octanol-water partition coefficient, sorption of 1,1,2-trichloroethane is expected to be limited. Dawson *et al*. (1980) state that sorption of 1,1,2-trichloroethane *will* be proportional to the organic content of soils and surface area of clays. Thus, its mobility in aquatic systems will be controlled mainly by the rate of water movement rather than sediment movement.

The persistence of 1,1,2-trichloroethane in subsurface soils and groundwater will be controlled by hydrolysis. Biodegradation has been found to occur, but usually under anaerobic conditions as a result of reductive dehalogenation (Bouwer and McCarty, 1983). Thus, biodegradation will not be important in aerated subsurface soils and groundwater. The rate of biodegradation is difficult to estimate on a site-specific basis.

The mobility of 1,1,2-trichloroethane in subsurface soils and groundwater will be high because it has little tendency for sorption.

ETHYLBENZENE

The behavior of ethylbenzene is controlled by its vapor pressure. Ethylbenzene will not persist in surface soils or aquatic systems because of its tendency to volatilize. Its estimated half-life in water is on the order of several hours (Callahan *et al*., 1979). Photo-oxidation of ethylbenzene in the atmosphere is rapid, with a half-life of about 15 hours (Callahan *et al*., 1979); this value is inferred based on the relative reactivity of ethylbenzene and reported conversion rates for m-xylene and 1,3,5-trimethylbenzene.

Oxidation of ethylbenzene readily occurs in the liquid phase, but the process appears to be inhibited by the presence of water (Stephens and Roduta, 1935). Hydrolysis is not expected to occur, according to Callahan *et al*. (1979). Thus, the persistence of ethylbenzene in surface soils and aquatic systems is largely controlled by volatilization.

Sorption of ethylbenzene may be a significant process and ethylbenzene will presumably be adsorbed by sedimentary organic material. Its mobility in aquatic systems may be controlled by sediment movement.

Ethylbenzene persistence in subsurface soils and groundwater will be high due to the insignificance of hydrolysis as a degradation mechanism. In addition, oxidation appears to occur only in the absence of water. Biodegradation is possible given appropriate acclimation of soil bacteria and aerobic conditions (Claus and Walker 1964; Gibson *et al*., 1966).

Rates of biodegradation are difficult to estimate on a site-specific basis.

METHYLENE CHLORIDE

The behavior of methylene chloride will be controlled by its vapor pressure. Methylene chlorine will not persist in surface soils or aquatic systems because of its tendency to volatilize. Callahan et al. (1979) give a volatilization half-life in water on the order of several minutes to a few hours depending upon the degree of agitation. In the atmosphere, methylene chloride degrades rapidly as a result of photo-oxidation by hydroxyl radical attack producing phosgene and chlorine oxide. Callahan et al. (1979) give a photo-oxidation half-life on the order of several months.

While hydrolysis of methylene chloride in water is possible, the rate of degradation is slow relative to volatilization. Callahan et al. (1979) present a minimum half-life of 18 months based on experimental work by Dilling et al. (1979). A maximum half-life of 704 years is also given based on an extrapolation made by Radding et al. (1977). Oxidation and photodecomposition are not significant, if they occur at all.

Sorption of methylene chloride will be limited given its octanol-water partition coefficient. The extent of sorption is controlled by the organic matter content and surface area of clays (Dawson et al., 1980). Methylene chloride mobility in aquatic systems will be controlled by water (rather than sediment) movement.

There is some uncertainty as to how persistent methylene chloride is in subsurface soils and groundwater. While hydrolysis can occur, it is difficult to estimate a rate of degradation. Given appropriate acclimation, biodegradation of methylene chloride is possible but at a very slow rate.

The mobility of methylene chloride in subsurface soils and groundwater will be high.

PHENOL

Photo-oxidation, metal-catalyzed oxidation, and biodegradation probably all contribute to the fate of phenol in the aquatic environment. Photo-oxidation will gradually occur, but only in aerated and clear surface waters. Callahan et al. (1979) suggests, however, that phenol may be nonphotolytically oxidized in highly aerated waters that also contain iron and copper.

Hydrolysis and volatilization of phenol are probably not environmentally significant processes. There is a possibility that some volatilization can occur, but, once in the atmosphere, phenol would be rapidly destroyed by oxidation in the troposphere. Since sorption of phenol is limited, it appears to be highly mobile in soils and groundwater.

Biodegradation is probably the most significant process in the environmental fate of phenol. Its microbial degradation has been observed in many laboratory and in situ studies.

Visser et al. (1977) estimated a removal rate of 30 ug/l per hour by bacteria in river water. Alexander and Lustingman (1966) reported that phenol was rapidly degraded by a mixed population of soil microbes.

PHTHALATE ESTERS

Phthalate's are a family of compounds whose environmental behavior may vary somewhat from compound to compound. In general, the mobility of the phthalates is controlled by their high affinity for sorption and, to some extent, by their limited solubilities. Although dimethyl and diethyl phthalate have moderate solubilities, most phthalates have very low solubilities. Their mobility is aquatic systems is mainly controlled by sediment transport processes. Ogner and Schnitzer (1970) suggest an interaction between phthalates and fulvic acid in humic substances in water and soil. The result is a very soluble complex, thus mobilizing and transporting otherwise insoluble phthalate esters.

Photolysis and oxidation are not expected to be significant processes. Hydrolysis is expected to occur in surface waters, but at very slow rates. The half-lives for the hydrolysis of phthalate esters are expected to be on the order of years (Callahan et al., 1979).

Vapor pressures for phthalate esters are extremely low and the evaporative half-life for bis(2-ethylhexyl)phthalate is estimated to be 15 years (Branson, 1978).

Phthalate esters are thought to undergo microbial degradation much more easily than other persistent compounds, such as PCB's (Engelhardt et al.). Half-lives have been reported on the range of 2 days for butyl benzyl phthalate to 4 weeks for bis(2-ethyl hexyl)phthalate (Callahan et al., 1979). Mathur (1974a) reported biodegradation in soils under aerobic conditions. Johnson and Lulves (1975) reported that degradation occurred much slower or not at all under anaerobic conditions.

Mobility of phthalate in subsurface soil and groundwater will be low to moderate depending upon the compound.

GLT533/26

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GLT533/25

Appendix D
METHODS FOR THE ENDANGERMENT ASSESSMENT

Appendix D
METHODS FOR THE ENDANGERMENT ASSESSMENT

This appendix presents the detailed methods used in the endangerment assessment. It has three sections:

- o Estimating Human Health Risks Caused by Carcinogens
- o Estimating Human Health Risks Caused by toxicants
- o Discussion of Uncertainty

ESTIMATING HEALTH RISKS CAUSED BY CARCINOGENS

To estimate human health risks from carcinogens, the following information must be known or derived:

- o Lifetime average ingestion rates for soil, sediment, water, and fish
- o Lifetime average dermal absorption rates for wading and swimming
- o Chemical concentration
- o Lifetime average chemical intake or dose
- o Cancer potency

The calculation of risk from carcinogens is based on a lifetime average daily dose per kilogram of body weight. Because the ingestion of water and possible ingestion of soil varies over a 70-year lifetime in relation to age and body weight, an age- and time-weighted average ingestion for water and soil is used. This accounts for the relatively higher ingestion rate per kilogram of body weight in the younger age classes.

The units on the cancer potency estimates from the U.S. EPA Carcinogen Assessment Group (CAG) are (mg/kg body weight/day)$^{-1}$. The lifetime average chemical intake (dose) must be estimated, therefore, in terms of mg of carcinogen/kg body weight/day so that:

$$\text{cancer risk} = 1\text{-exp}\ (-[\text{potency} \times \text{dose}]).$$

SOIL SEDIMENT INGESTION-RESIDENTIAL SETTING

Lifetime Average Ingestion Rates

The lifetime average soil or sediment ingestion rate (LASI, in grams soil or sediment per kilogram of body weight/day) for the residential setting is estimated from:

$$LASI = \frac{1}{N} \sum_{i=0.01}^{N} \frac{s_i}{b_i}$$

where:

N = number of years in a lifetime (assume 70)
s_i = soil or sediment ingestion in year i (gm/day)
b_i = body weight in year i(kg)

For a 70-year lifetime, the LASI estimated LASI is as 0.028 gm/kg body weight/day based on the data in Table D-1. The derivation of this is shown in Table D-2.

Dose Calculation

The lifetime average chemical intake from soil or sediment (LACIS) ingestion is the lifetime dose from soil or sediment ingestion.

The lifetime average chemical intake from soil or sediment ingestion (LACIS) is:

$$LACIS = LASI \times C_s \times f$$

where:

C_s = soil or sediment chemical concentration
f = fraction of year that exposure occurs
$[f = 1 - (\frac{\text{No. of days exposure prevented}}{365.25})]$
$[f = 1 - (295/365.25) = 0.47]$

For the soil or sediment ingestion or inhalation route, the exposure duration represents the number of days that an individual will contact the contaminated soil or sediment. In a residential setting, behavior patterns and seasonal conditions will most influence the duration of exposure. Children and adults who enjoy outdoor activities and household pets could contact soil or sediment frequently. Cold or wet weather usually deters outdoor activities and decreases exposure. Similarly, dust generation and the resulting exposure is essentially eliminated when the soil or sediment is wet or frozen.

Near Indianapolis, the soil or sediment could be frozen an average of 120 days/year (NOAA, 1980). Dust emissions are considered negligible on days when precipitation exceeds 0.01 inch (Kimbrough et al., 1984), which is reported to be an average of 123 days/year for the area around Boone County,

Table D-1
ESTIMATED SOIL OR SEDIMENT AND WATER INGESTION
BY BODY WEIGHT AND AGE

Age (Years)	Body Weight (kg)	Estimated Ingested Sediment[a] (gm/day)	Estimated Ingested Drinking Water (L/day)
0-0.75	5	0	1
0.75-1.5	8	1	1
1.5-3.5	12	10	1
3.5-5	15	1	1
5-18	38	0.1	1.4
≥18	70	0.1	2

[a]From Kimbrough et al., 1984.

GLT360/63

Table D-2 (page 1 of 3)
LIFETIME AVERAGE CHEMICAL INTAKE DERIVATIONS

LIFETIME AVERAGE SOIL OR SEDIMENT INTAKE DERIVATION (LASI)

(365.25 days x 0.75 yr) x 0 gm ÷ 5 kg	=	0
(365.25 days x 0.75 yr) x 1 gm ÷ 8 kg	=	34
(365.25 days x 2.0 yr) x 10 gm ÷ 12 kg	=	610
(365.25 days x 1.5 yr) x 1 gm ÷ 15 kg	=	37
(365.25 days x 13 yr) x 0.1 gm ÷ 38 kg	=	13
(365.25 days x 52 yr) x 0.1 gm ÷ 70 kg	=	27

721 gm/kg/70 yr
10 gm/kg/year
0.028 gm/kg/day

LIFETIME AVERAGE WATER INTAKE DERIVATION (LAWI)

(365.25 days x 0.75 yr) x 1 L/day ÷ 5 kg	=	55
(365.25 days x 0.75 yr) x 1 L/day ÷ 9 kg	=	34
(365.25 days x 2.0 yr) x 1 L/day ÷ 12 kg	=	61
(365.25 days x 1.5 yr) x 1 L/day ÷ 15 kg	=	37
(365.25 days x 13 yr) x 1.4 L/day ÷ 38 kg	=	170
(365.25 days x 52 yr) x 2 L/day ÷ 70 kg	=	540

897.022 L/kg/70 years
12.8 L/kg/year
0.035 L/kg/day

LIFETIME AVERAGE DAILY DERMAL ABSORPTION DERIVATION (LADDA) FOR WADING IN UNNAMED DITCH

3.5 years x (0.001 L/cm² x hrs)[a] x 0 hrs/yr x 0% immersed x 4,000[a] cm² ÷ 9.6 kg = 0 L/kg
14.5 years x (0.001 L/cm² x hr)[a] x 2.5 hrs/yr x 25% immersed x 8,800[a] cm² ÷ 35.6 kg = 2.24 L/kg
52 years x (0.001 L/cm² x hr)[a] x 1.25 hrs/yr x 25% immersed x 18,000[a] cm² ÷ 70 kg = 1.67 L/kg

3.91 L/kg-70 years
0.056 L/kg-year
0.00015 L/kg-day

Assumptions for LADDA from Wading in Unnamed Ditch

Infants do not wade.
Children wade 10 times per year for 15 minutes each time and 25 percent immersed.
Adults wade 5 times per year for 15 minutes each time and 10 percent immersed.

LIFETIME AVERAGE DAILY DERMAL ABSORPTION DERIVATION (LADDA) FOR WADING IN FINLEY AND EAGLE CREEK

3.5 years x $(0.001\ L/cm^2 \times hrs)^a$ x 0 hrs/yr x 0% immersed x
$4{,}000^a\ cm^2 \div 9.6\ kg = 0\ L/kg$
14.5 years x $(0.001\ L/cm^2 \times hr)^a$ x 2.5 hrs/yr x 50% immersed x
$8{,}800^a\ cm^2 \div 35.6\ kg = 4.4803\ L/kg$
52 years x $(0.001\ L/cm^2 \times hr)^a$ x 1.25 hrs/yr x 25% immersed x
$18{,}000^a\ cm^2 \div 70\ kg = 4.18\ L/kg$

8.66 L/kg-70 years
0.124 L/kg-year
0.00034 L/kg-day

Assumptions for LADDA from Wading in Finley and Eagle Creek

Infants do not wade.
Children wade 10 times per year for 15 minutes each time and 50 percent immersed.
Adults wade 5 times per year for 15 minutes each time and 25 percent immersed.

LIFETIME AVERAGE DAILY DERMAL INTAKE DERIVATION (LADDI) FROM BATHING

Infant 3.5 yr x $(0.001\ L/cm^2 \times hours)^a$ x 65 hours[b]/yr x 80% immersed x $4{,}000\ cm^2 \div 9.6\ kg = 75.8\ L/kg$

Child 14.5 yr x $(0.001\ L/cm^2 \times hours)^a$ x 65 hours[b]/yr x 80% immersed x $8{,}800\ cm^2 \div 35.6\ kg = 186\ L/kg$

Adult 52 yr x $(0.001\ L/cm^2 \times hours)^a$ x 65 hours[b]/yr x 80% immersed x $18{,}000\ cm^2 \div 70\ kg = 695\ L/kg$

957 L/kg - 70 yr
13.7 L/kg-yr
0.037 L/kg-day

Assumptions for LADDI for Bathing

People bath 5 times per week[b], 15 minutes each time and[b] are 80% immersed.

FISH INGESTION

Lifetime Average Daily Fish Ingestion

365.25 days x 3.5 years x 0 gm of fish/day ÷ 9.6 kg body weight =
0 gm of fish/kg body weight

365.25 days x 14.5 years x 3.25 gm of fish/day ÷ 36.5 kg body weight =
483.4946 gm of fish/kg body weight

365.25 days x 52 years 6.5 gm of fish/day[c] ÷ 70 kg body weight =
1763.6357 gm of fish/kg body weight

2247.1303 g of fish/kg - 70 years
32.1019 g of fish/dk - year
0.088 g of fish/kg - day

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[a] From Brown et al., 1984
[b] From ICF, Environ, 1983

GLT360/64

Indiana, (NOAA 1980). NOAA reports that for Indianapolis approximately 60 percent of the precipitation days occur outside of the winter months. Thus, Boone County has approximately 193 days/year (120 + 60 percent of 123) when climatic conditions would deter outdoor activity and reduce dust emissions.

The life average chemical intake from soil or sediment ingestion for the ECC site may be estimated as:

$$LACIS = LASI \times Cs \times f$$

where:

$$f = 1 - (193/365.25) = 0.47$$

so that:

$$LACIS = 0.028 \times 0.47 \times Cs$$

$$LACIS = 0.013 \times Cs$$

Risk Estimation

The excess lifetime cancer risk from soil or sediment ingestion is estimated as:

$$R_i = 1 - \exp\left(-[P_i \times LACIS_i \div 1{,}000]\right)$$

where:

R_i = lifetime excess risk from chemical i
P_i = potency of carcinogen obtained from EPA CAG $(mg/kg\text{-}day)^{-1}$
C_i = concentration of chemical i (mg/kg)
LASI = lifetime average soil or sediment ingestion rate (mg/kg-day)
f = fraction of lifetime exposure occurs

SOIL OR SEDIMENT OCCUPATIONAL EXPOSURE

Lifetime Average Ingestion Rate

The LASI for adult workers was calculated:

$$LASI = \frac{n}{N} \times \frac{s_i}{b_i}$$

where:

N	=	number of years in a lifetime (70)
s_i	=	sediment ingestion for adult (0.1 gm/day)
b_i	=	body weight of adult (70 kg)
n	=	number of working years in a lifetime (40)

LASI was estimated as 0.00082 gm/kg body weight/day.

Lifetime Average Chemical Intake

The LACIS is derived for occupational exposure using the following assumptions.

As for residents, the assumption was made that approximately 193 days/year or 53 percent of the days/year have climatic conditions which would deter working outdoors and/or prevent dust emissions. Therefore, 47 percent of the time climatic conditions would be favorable for working outdoors and potential for exposure to sediment probable.

Considering the weekends (104 days) and estimated time allotted for vacations (10 days) and holidays (8 days), the average work period is 243.25 days/year and only 8 hours/day are spent at work.

The LACIS is therefore:

$$LACIS = LASI \times C_s \times f$$

where:

$$\begin{aligned} f &= \text{fraction of year exposure occurs} \\ &= (1-(193/365.25) \times (243.25/365.25) \times (8/16) \\ &= 0.16 \end{aligned}$$

C_s = sediment chemical concentration

so:

$$\begin{aligned} LACIS &= 0.00082 \times 0.16 \times C_s \\ &= 0.00013 \times C_s \end{aligned}$$

Risk Estimation - Occupational Exposure

The excess lifetime cancer risk from soil or sediment ingestion in the occupational setting is calculated in the same way as the residential setting.

DERMAL ABSORPTION RESIDENTIAL SETTING

Lifetime Average Dermal Absorption Rates

The lifetime average daily dermal absorption (LADDA, in L/kg body weight/day) for residents was estimated from:

$$LADDA = \frac{1}{N} \sum_{i=1}^{N} \frac{w_i}{b_i}$$

where:

N = number of years in a lifetime (70)
b_i = body weight in year i (kg)
w_i = dermal absorption in year i (1/day)

For a 70-year lifetime, LADDA for bathing and wading is estimated as 0.037 1/kg/day and 0.00034 1/kg/day, respectively, based on the data in Table D-1. The derivation of this is shown in Table D-2.

Dose Calculation

The lifetime average chemical dermal dose from dermal absorption, LACDD, is:

$$LACDD = LADDA \times C_w$$
$$= 0.00034 \times C_w$$

where:

C_w = water chemical concentration mg/1

Risk Estimation

The excess lifetime cancer risk from residential dermal absorption was estimated as:

$$R_i = 1 - \exp(-[P_i \times C_i \times LADDA])$$

where:

$$LACDD = C_i \times LADDA$$

therefore:

$$R_i = 1 - \exp(-[P_i \times LACDD_i])$$

where:

R_i = lifetime excess risk from chemical i

P_i = potency of carcinogen obtained from EPA's CAG (kg-day/mg)

C_i = concentration of chemical i (mg/l)

LADDA = lifetime average daily dermal absorption (L/kg-day)

WATER INGESTION-RESIDENTIAL SETTING

Lifetime Average Ingestion Rates

The lifetime average drinking water intake (LAWI, in L/kg body weight/day) for residents is estimated from:

$$\text{LAWI} = \frac{1}{N} \sum_{i=1}^{N} \frac{w_i}{b_i}$$

where:

N = number of years in a lifetime (70)
b_i = body weight in year i (kg)
w_i = drinking water intake in year i (L/day)

For a 70-year lifetime, LAWI is estimated as 0.035 L/kg/day based on the data in Table D-1. The derivation of this is shown in Table D-2.

Dose Calculation

The lifetime average chemical intake from water ingestion is the lifetime dose from water ingestion.

The lifetime average chemical intake from drinking water, LACIW, is:

$$\text{LACIW} = \text{LAWI} \times C_w \times f = 0.035 \times C_w$$

where:

C_w = water chemical concentration, mg/l

f = fraction of lifetime exposed to contaminated drinking water (f = 1)

Risk Estimation

The excess lifetime cancer risk from residential water ingestion is estimated as:

$$R_i = 1 - \exp(-[P_i \times C_i \times LAWI \times f])$$

but since:

$$LACIW = C_i \times LAWI \times f$$

then,

$$R_i = 1 - \exp(-[P_i \times LACIW_i])$$

where:

R_i = lifetime excess risk from chemical i

P_i = potency of carcinogen obtained from EPA's CAG $(mg/kg\text{-}day)^{-1}$

C_i = concentration of chemical i (mg/l)

LAWI = lifetime average water intake (L/kg-day)

f = fraction of lifetime that exposure occurs

FISH INGESTION

Lifetime Average Daily Fish Ingestion Rate

The lifetime average daily fish fillet ingestion (LADFI, in mg/kg body weight/day) assuming only fish fillets from Finley Creek, is estimated from:

$$LADFI = \frac{n}{N} \times \frac{f_i}{b_i}$$

where:

N = number of years in lifetime (70 years)
n = number of years fish fillets are consumed (66.5 years assumed)
f_i = daily fish fillet ingestion (6.5 grams)
b_i = body weight of adult (70 kg)

LADFI was estimated as 0.088 g/kg body weight/day.

Dose Calculation

The lifetime average chemical intake from fish fillet ingestion results in an average lifetime dose from fish consumption.

The lifetime average chemical intake from fish ingestion LACFI is:

$$LACFI = LADFI \times C_f = 0.088 \times C_f$$

where:

C_f = chemical concentration in fish fillets (edible portion)

Since no fish samples were obtained the concentration in fish may be estimated by multipling water concentration by the bioconcentration factors found in the literature.

Risk Estimation

The excess lifetime cancer risk from fish ingestion is estimated as:

$$R_i = 1 = \exp\ (P_i \times C_f \times LADFI \div 1{,}000])$$

but since:

$$LACFI = C_f \times LADFI$$

then,

$$R_i = 1 - \exp\ (-[P_i \times LACFI \div 1{,}000])$$

where:

R_i = lifetime excess risk from chemical
P_i = potency of carcinogens obtained from U.S. EPA's CAG $(mg/kg\text{-}day)^{-1}$
C_f = concentration of chemical; in fish fillets in (mg/kg)
LADFI = lifetime average fish ingestion (g/kg-day)

ESTIMATING RISKS FOR TOXICANTS FOR COMPARISON TO ADI'S

The intake of various compounds from different environmental media requires the derivation of not only how much of the compound is in the water or soil, or sediment but also how much water or soil is ingested. The derivation of average daily intake of compounds is calculated from assumed rates of intake for soil or sediment and water.

SOIL OR SEDIMENT

The average daily intake from soil ingestion is estimated as:

$$I_i = C_i \times D_s$$

when: I_i = daily intake of chemical (mg/day),
C_i = concentration of chemical in soil (mg/kg), and
D_s = daily soil intake.

Daily soil intake is:

- o 1 gram per day for children in the residential setting.
- o 0.1 gram per day for adults in the residential setting.
- o 0.05 gram per day for adults in the occupational setting

WATER

The average daily intake from water ingestion is estimated as:

$$I_i = C_i \times D_w$$

where: I_i = daily intake of chemical (mg/day)
C_i = concentration of chemical in water (mg/l)
D_w = daily water intake

Daily water intake is:

2 liters per day for the residential setting, and
1 liter per day for the adult worker setting.

DISCUSSION OF UNCERTAINTY

The methods and factors that may lead to an overestimate of the health risks are:

- o The exposure to and concentration of contaminants is held constant over a 70-year lifetime. Chemical fate mechanisms may reduce actual concentrations. Exposure reflect upper bound estimate and may vary with time.

- Chemical concentrations reported as "detected but less than the quantification limit" in the RI report are used in this exposure assessment as equal to the quantification limit. The actual chemical concentration would be between one-half the quantification limit and the quantification limit. The overestimate would be no greater than an order-of-magnitude.

- Projected release from soil to groundwater based on maximum concentrations may be 2 to 3 orders-of-magnitude higher than actual release. These risks based on these values may be therefore 2 to 3 orders-of-magnitude lower.

- The release of chemicals from the soil to groundwater used treats the rate of release for all chemicals as equal. There actually will be differential release rate with overall contaminant concentration being less.

- Calculation for chemical ingestion assumes 100 percent absorption into the body. The actual percentage absorbed may be less.

- Health risks associated with exposure to groundwater are calculated based on maximum concentrations.

- Data do not distinguish between valence states (hexavalent or trivalent) for chromium. Chromium intake is compared to the acceptable daily intake (ADI) for hexavalent chromium in all media. The toxicity of hexavalent chromium is greater than that of trivalent chromium.

- All of the daily drinking water ingested is from the groundwater source in question.

Factors that may lead to an underestimate of the health risks are:

- Exposure through dust or vapor inhalation is not quantified. Dermal absorption of chemicals through contact with soil or water is also not quantified (except for exposure to volatiles via bathing and wading), due to uncertainty inherent in attempting such a quantification. The risks associated with inhalation are addressed qualitatively.

- Some chemicals detected at the site are toxicants or suspected carcinogens. For some of these chemicals, cancer potencies or ADI's are not available, therefore their effect on human health is not quantifiable. This may lead to an underestimation of risk when comparing daily intakes to acceptable intake levels because intakes from the site could provide the incremental difference needed to exceed the allowable intake values.

Factors that may lead to either an overestimate or an underestimate of the health risks are:

- The assumptions regarding body weight, average lifetime, population characteristics, and lifestyle may not be representative for the population around the site.

- The exposure duration parameters are based on assumptions regarding behavior patterns and various physical phenomena (such as precipitation and days of frozen soil). These factors are based on published data.

- Risk are assumed to be additive. Risks may not be additive because of potention or antagonistic actions of other chemicals.

- Substantial uncertainties are inherent in the estimation of risk. Uncertainties may act to either increase or decrease risk, depending upon the source of uncertainty. Cancer potencies are primarily derived using laboratory animal studies and, when available, human occupational studies. Extrapolation of data from high to low dose, from one species to another, and from one exposure route to another introduces uncertainty.

- Not all carcinogenic potencies used represent the same degree of certainty. All are subject to change as new evidence becomes available.

GLT360/62

Appendix E
RISK ASSESSMENT BY OPERABLE UNIT

Appendix E
RISK ASSESSMENT BY OPERABLE UNIT

SOIL AND SEDIMENT

For the analysis of the potential impacts from soil or sediment ingestion, assumptions in Table 6-4 and Appendix D are used. It is assumed that contaminated soil at depth could be inadvertently exposed during site development. It is also assumed that contaminated sediment can be transported and could occur at the site and at any point along the length of the unnamed ditch and Finley Creek.

Table E-1 lists the constituents identified in the soil and sediment samples for the ECC site, unnamed ditch and Finley Creek during the RI. The exposure assessment is based on average and maximum observed contaminant concentrations. Organic chemical concentrations reported as "less than the quantitation limit" in the RI report are used in this exposure assessment as equal to the quantitation limit. Actual organic chemical concentrations would be less than the quantitation limit. Organic chemical concentrations reported as semiquantitative or qualitative are also used in this assessment quantitatively. The values for inorganic information reflect only concentrations above the 95 percent confidence limit of background levels. Inorganic chemical concentrations reported as less than the quantitation limit in the RI report are assumed to be zero for this assessment. Inorganic elements are treated as elements or simple inorganic salts.

Tables E-2 through E-8 summarize the soil and sediment contamination, cancer risks, and intakes for noncarcinogens for the ECC site for both residents and adult workers.

GROUNDWATER

Analysis of the groundwater monitoring well samples at ECC yielded 20 metals, 17 volatile organic compounds, and 6 base/neutral compounds. As Table E-9 indicates, a majority of these compounds were either found only once, below quantification limits, or at levels in the same range as the upgradient background wells or the blank. The maximum concentrations found in the groundwater are used in determining the upper bound risk associated with groundwater at this site (see Table 6-4).

In using the groundwater monitoring data the following judgments are made:

Table E-1
PRIORITY POLLUTANTS FOUND IN SOIL AND SEDIMENT AT THE ECC SITE

Volatiles

Benzene (C)(W)
Chlorobenezne
1,1,1-Trichloroethane
1,1,2-Trichloroethane (C)
Chloroform (C)
1,1-Dichloroethene (C)(I)
Trans-1,2-dichloroethene
Ethylbenzene
Methylene Chloride (C)
Tetrachloroethene (C)
Toluene
Trichloroethene (C)
Vinyl Chloride (C)(I)
Xylene Acids
Phenol

Pesticides/PCB's

PCB 1232 (C)
PCB 1260 (C)

Metals

Antimony
Arsenic (C)(H)
Beryllium (C)
Cadmium (C)(W)
Chromium (C)(W)
Copper
Cyanide
Lead
Mercury
Nickel (C)(W)
Silver
Zinc

Base/Neutrals

1,2-Dichlorobenzene
Isophorone
Naphthalene
Bis(2-ethyl hexyl) phthalate
Butylbenzyl phthalate
Di-n-butyl phthalate
Diethyl phthalate
Dimethyl phthalate
Benzo(a)anthrancene
Benzo(a)pyrene (C)
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Chrysene
Benzo(ghi)perylene
Dibenzo(a,h)anthracene
Indeno(1,2,3-cd) pyrene

C = Carcinogenic.
W = Carcinogenic based on human occupational exposure.
I = Carcinogenic based on animal inhalation studies.
H = Carcinogenic based on human drinking water exposure.

GLT360/55

APPENDIX E TABLE 2
ECC SOUTH PAD INTERMEDIATE DEPTH SOIL CONTAMINATION AND EXPOSURE VIA INGESTION

	Potency (mg/kg-day)-1	Maximum Observed Conc. ug/kg	Cancer Risk Residential 0.013 g of soil/kg-day	Cancer Risk Worker 0.00013 g of soil/kg-day	Average Conc. ug/kg	Cancer Risk Residential 0.013 g of soil/kg-day	Cancer Risk Worker 0.00013 g of soil/kg-day	Acceptable Daily Intake (ADI) ug/day	Intake in ug/day at Max. Conc. at ingestion of 10.00 g/day	Intake in ug/day at Max. Conc. at ingestion of 1.00 g/day	Intake in ug/day at Max. Conc. at ingestion of 0.10 g/day	Intake in ug/day at Ave. Conc. at ingestion of 10.00 g/day	Intake in ug/day at Ave. Conc. at ingestion of 1.00 g/day	Intake in ug/day at Ave. Conc. at ingestion of 0.10 g/day
Carcinogens														
Organics														
Volatiles														
1,1,2-Trichloroethane d	5.73E-02	150	1.1E-07	1.1E-09	20	1.5E-08	1.5E-10							
Chloroform c	7.00E-02	2900	2.6E-06	2.6E-08	370	3.4E-07	3.4E-09							
Methylene Chloride d	6.30E-04	10000 e	8.2E-08	8.2E-10	2161 e	1.0E-08	1.0E-10							
Tetrachloroethene d	3.50E-02	18000	8.2E-06	8.2E-08	3634	1.7E-06	1.7E-08							
Trichloroethene d	1.90E-02	110000	2.7E-05	2.7E-07	22379	5.5E-06	5.5E-08							
Inorganics														
Beryllium b		300 f			106 f			30	4	0.4	0.04	2	0.2	0.02
Cadmium b		4400			550			170	44	4.4	0.44	6	0.6	0.06
Chromium		300												
+6 a								175	3	0.3	0.03			
+3								125000	3	0.3	0.03			
TOTAL			3.8E-05	3.8E-07		7.6E-06	7.6E-08							
Noncarcinogens														
Organics														
Volatiles														
1,1,1-Trichloroethane		49000			13139			38000	490	49.0	4.90	131	13.1	1.31
Ethylbenzene		21000			3230			9500	210	21.0	2.10	32	3.2	0.32
Toluene		31000			7863			30000	310	31.0	3.10	79	7.9	0.79
Total Xylenes		110000			16765			1200 g	1100	110.0	11.00	168	16.8	1.68
Base/Neutrals, Acids														
Phenol		1100			214			7000	11	1.1	0.11	2	0.2	0.02
Isophorone		500			62			11000	5	0.5	0.05	1	0.1	0.01
Bis(2-ethylhexyl)Phthalate	6.84×10^-4	730			120			42000	7	0.7	0.07	1	0.1	0.01
Di-n-butyl Phthalate		420 e,f			149 e,f			88000	4	0.4	0.04	1	0.1	0.01
Diethyl Phthalate		9000			1275			880000	90	0.9	0.90	13	1.3	0.13
Dimethyl Phthalate		1200			195			700000	12	1.2	0.12	2	0.2	0.02
Inorganics														
Lead		9200						100 h	92	9.2	0.92	0	0.0	0.00
Silver		3300 f			412 f			100	33	3.3	0.33	4	0.4	0.04

a-The International Agency for Research on Cancer(IARC) has assigned this to Group 1-"the chemical is causally associated with cancer in humans."
b-The International Agency for Research on Cancer(IARC) has assigned this to Group 2A-"the chemical has limited evidence of carcinogenicity to humans."
c-The International Agency for Research on Cancer(IARC) has assigned this to Group 2B-"the chemical has sufficient evidence of carcinogenicity in animals but inadequate data in humans."
d-The International Agency for Research on Cancer(IARC) has assigned this to Group 3-"the chemical cannot be classified as to its carcinogenicity to humans."
e-Analyte found in laboratory blanks as well as sample, indicates probable contamination.
f-Estimated value, concentration less than specified detection limit but greater than zero.

APPENDIX E TABLE 3
ECC SOUTH PAD DEEP SOIL CONTAMINATION AND EXPOSURE VIA INGESTION

	Potency (mg/kg-day)-1	Maximum Observed Conc. ug/kg	Cancer Risk Residential 0.013 g of soil/kg-day	Cancer Risk Worker 0.00013 g of soil/kg-day	Average Conc. ug/kg	Cancer Risk Residential 0.013 g of soil/kg-day	Cancer Risk Worker 0.00013 g of soil/kg-day	Acceptable Daily Intake(ADI) ug/day	Intake in ug/day at Max. Conc. at ingestion of 10.00 g/day	Intake in ug/day at Max. Conc. at ingestion of 1.00 g/day	Intake in ug/day at Max. Conc. at ingestion of 0.10 g/day	Intake in ug/day at Ave. Conc. at ingestion of 10.00 g/day	Intake in ug/day at Ave. Conc. at ingestion of 1.00 g/day	Intake in ug/day at Ave. Conc. at ingestion of 0.10 g/day
Carcinogens														
Organics														
Volatiles														
Chloroform b	7.00E-02	5 e	4.6E-09	4.6E-11	1 e	9.1E-10	9.1E-12							
Methylene Chloride c	6.30E-04	190	1.6E-09	1.6E-11	60 d	5.6E-10	5.6E-12							
Tetrachloroethene c	3.50E-02	8	3.6E-09	3.6E-11	2	9.1E-10	9.1E-12							
Trichloroethene c	1.90E-02	76	1.9E-08	1.9E-10	16	4.0E-09	4.0E-11							
Inorganics														
Beryllium a		390 e			56 e			38	4	0.4	0.04	1	0.1	0.01
Cadmium a		4100			506			170	41	4.1	0.41	6	0.6	0.06
TOTAL			2.9E-08	2.9E-10		6.3E-09	6.3E-11							
Noncarcinogens														
Organics														
Volatiles														
1,1,1-Trichloroethane		110			24			30000	1	0.1	0.01	0	.0	.00
Toluene		120			33			30000	1	0.1	0.01	0	.0	.00
Total Xylenes		11			2			1200 f	0	.0	.00	0	.0	.00
Base/Neutrals,Acids														
Bis(2-ethylhexyl)Phthalate		270 e			54 e			42000	3	0.3	0.03	1	0.1	0.01
Di-n-butyl Phthalate		310 d			62 d			80000	3	0.3	0.03	1	0.1	0.01
Inorganics														
Lead		200						100 g	2	0.2	0.02			

a-The International Agency for Research on Cancer(IARC) has assigned this to Group 2A-"the chemical has limited evidence of carcinogenicity to humans."
b-The International Agency for Research on Cancer(IARC) has assigned this to Group 2B-"the chemical has sufficient evidence of carcinogenicity in animals but inadequate data in humans."
c-The International Agency for Research on Cancer(IARC) has assigned this to Group 3-"the chemical cannot be classified as to its carcinogenicity to humans."
d-Analyte found in laboratory blanks as well as sample,indicates probable contamination.
e-Estimated value,concentration less than specified detection limit but greater than zero.
f-ADI derived from chronic drinking water criteria of 0.62 mg/L x2L/day= 1.2mg/day.
g-ADI derived from maximum contaminant limit of 0.05 mg/L x 2 L/day= 0.1 mg/day.

APPENDIX E TABLE 4

ECC NORTH TEST PITS SHALLOW DEPTH SOIL CONTAMINATION AND EXPOSURE VIA INGESTION

	Potency (mg/kg-day)-1	Maximum Observed Conc. ug/kg	Cancer Risk Residential 0.013 g of soil/kg-day	Cancer Risk Worker 0.00013 g of soil/kg-day	Average Conc. ug/kg	Cancer Risk Residential 0.013 g of soil/kg-day	Cancer Risk Worker 0.00013 g of soil/kg-day	Acceptable Daily Intake(ADI) ug/day	Intake in ug/day at Max. Conc. at ingestion of 10.00 g/day	Intake in ug/day at Max. Conc. at ingestion of 1.00 g/day	Intake in ug/day at Max. Conc. at ingestion of 0.10 g/day	Intake in ug/day at Ave. Conc. at ingestion of 10.00 g/day	Intake in ug/day at Ave. Conc. at ingestion of 1.00 g/day	Intake in ug/day at Ave. Conc. at ingestion of 0.10 g/day
Carcinogens														
Organics														
Volatiles														
1,1,2-Trichloroethane d	5.73E-02	550	4.1E-07	4.1E-09	39	2.9E-08	2.9E-10							
Methylene Chloride d	6.30E-04	310000	2.5E-06	2.5E-08	32786	2.7E-07	2.7E-09							
Tetrachloroethene d	3.50E-02	650000	3.0E-04	3.0E-06	52062	2.4E-05	2.4E-07							
Trichloroethene d	1.90E-02	4000000 e	1.2E-03	1.2E-05	354335 e	8.8E-05	8.8E-07							
Pesticides/PCB's														
PCB's c	4.34E+00	39000	2.2E-03	2.2E-05	2933	1.7E-04	1.7E-06							
Inorganics														
Arsenic a	1.50E+01	200	3.9E-05	3.9E-07										
Beryllium b		3900 f			735 f			38	39	3.9	0.39	7	0.7	0.07
Cadmium b		4500			886			170	45	4.5	0.45	9	0.9	0.09
Chromium		113300 g			28586 g									
+6 a								175	1133	113.3	11.33	286	28.6	2.86
+3								125000	1133	113.3	11.33	286	28.6	2.86
TOTAL			3.7E-03	3.7E-05		2.8E-04	2.8E-06							
Noncarcinogens														
Organics														
Volatiles														
Chlorobenzene		360			26			1000	4	0.4	0.04	0	.0	.00
1,1,1-Trichloroethane		1100000			103483			38000	11000	1100.0	110.00	1035	103.5	10.35
Ethylbenzene		1500000			148844			9500	15000	1500.0	150.00	1488	148.8	14.88
Toluene		2000000			260824			30000	20000	2000.0	200.00	2608	260.8	26.08
Total Xylenes		6800000			629857			1200 h	68000	6800.0	680.00	6299	629.9	62.99
Base/Neutrals,Acids														
Phenol		570000			40714			7000	5700	570.0	57.00	407	40.7	4.07
Isophorone		440000			31766			11000	4400	440.0	44.00	318	31.8	3.18
Bis(2-ethylhexyl)Phthalate		370000			38943			42000	3700	370.0	37.00	389	38.9	3.89
Di-n-butyl Phthalate		8200			699			80000	82	8.2	0.82	7	0.7	0.07
Inorganics														
Lead		376200 g			71686 g			100 i	3762	376.2	37.62	717	71.7	7.17
Cyanide		2900			357			7600	29	2.9	0.29	4	0.4	0.04
Nickel		126200 f						1500	1262	126.2	12.62			
Silver		3800 f			271 f			100	38	3.8	0.38	3	0.3	0.03

a-The International Agency for Research on Cancer(IARC) has assigned this to Group 1-"the chemical is causally associated with cancer in humans."
b-The International Agency for Research on Cancer(IARC) has assigned this to Group 2A-"the chemical has limited evidence of carcinogenicity to humans."
c-The International Agency for Research on Cancer(IARC) has assigned this to Group 2B-"the chemical has sufficient evidence of carcinogenicity in animals but inadequate data in humans."
d-The International Agency for Research on Cancer(IARC) has assigned this to Group 3-"the chemical cannot be classified as to its carcinogenicity to humans."
e-Analyte found in laboratory blanks as well as sample, indicates probable contamination.
f-Estimated value, concentration less than specified detection limit but greater than zero.
g-Duplicate analysis is not within control limits.

APPENDIX E TABLE 5
ECC NORTH TEST PITS INTERMEDIATE DEPTH SOIL CONTAMINATION AND EXPOSURE VIA INGESTION

	Potency (mg/kg-day)-1	Maximum Observed Conc. ug/kg	Cancer Risk Residential 0.013 g of soil/kg-day	Cancer Risk Worker 0.00013 g of soil/kg-day	Average Conc. ug/kg	Cancer Risk Residential 0.013 g of soil/kg-day	Cancer Risk Worker 0.00013 g of soil/kg-day	Acceptable Daily Intake(ADI) ug/day	Intake in ug/day at Max. Conc. at ingestion of 10.00 g/day	Intake in ug/day at Max. Conc. at ingestion of 1.00 g/day	Intake in ug/day at Max. Conc. at ingestion of 0.10 g/day	Intake in ug/day at Ave. Conc. at ingestion of 10.00 g/day	Intake in ug/day at Ave. Conc. at ingestion of 1.00 g/day	Intake in ug/day at Ave. Conc. at ingestion of 0.10 g/day
Carcinogens														
Organics														
Volatiles														
1,1,2-Trichloroethane d	5.73E-02	62	4.6E-08	4.6E-10	7	5.2E-09	5.2E-11							
Methylene Chloride d	6.30E-04	4400	3.6E-08	3.6E-10	741	6.1E-09	6.1E-11							
Tetrachloroethene d	3.50E-02	29000	1.3E-05	1.3E-07	6111	2.8E-06	2.8E-08							
Trichloroethene d	1.90E-02	66000	1.6E-05	1.6E-07	7545	1.9E-06	1.9E-08							
Pesticides/PCB's														
PCB's c	4.34E+00	1700	9.6E-05	9.6E-07	249	1.4E-05	1.4E-07							
Inorganics														
Arsenic a	1.50E+01	3200	6.2E-04	6.2E-06										
Beryllium b		2000 f			563 f			30	20	2.0	0.20	5.63	0.56	0.06
Cadmium b		27000 e			3867 e			170	270	27.0	2.70	38.67	3.87	0.39
Chromium		127300			15078									
+6 a								175	1273	127.3	12.73	151	15.1	1.51
+3								125000	1273	127.3	12.73	151	15.1	1.51
TOTAL			7.5E-04	7.5E-06		1.9E-05	1.9E-07							
Noncarcinogens														
Organics														
Volatiles														
1,1,1-Trichloroethane		7700			103483			38000	77	7.7	0.77	1035	103.5	10.35
Ethylbenzene		20000			148844			9500	200	20.0	2.00	1488	148.8	14.88
Toluene		19000			260824			30000	190	19.0	1.90	2608	260.8	26.08
Total Xylenes		100000			629857			1200 g	1000	100.0	10.00	6299	629.9	62.99
Base/Neutrals,Acids														
Phenol		25000			40714			7000	250	25.0	2.50	407	40.7	4.07
Isophorone		17000			31766			11000	170	17.0	1.70	318	31.8	3.18
Bis(2-ethylhexyl)Phthalate		25000			38943			42000	250	25.0	2.50	389	38.9	3.89
Di-n-butyl Phthalate		3900			699			88000	39	3.9	0.39	7	0.7	0.07
Dimethyl Phthlate		1300			144			7000000	13	1.3	0.13	1	0.1	0.01
Inorganics														
Antimony		42000			4667			290	420	42.0	4.20	47	4.7	0.47
Lead		415200 e			60189 e			100 h	4152	415.2	41.52	602	60.2	6.02
Cyanide		4400			595			7600	44	4.4	0.44	6	0.6	0.06
Silver		3800 f			422 f			100	38	3.8	0.38	4	0.4	0.04

a-The International Agency for Research on Cancer(IARC) has assigned this to Group 1-"the chemical is causally associated with cancer in humans."
b-The International Agency for Research on Cancer(IARC) has assigned this to Group 2A-"the chemical has limited evidence of carcinogenicity to humans."
c-The International Agency for Research on Cancer(IARC) has assigned this to Group 2B-"the chemical has sufficient evidence of carcinogenicity in animals but inadequate data in
d-The International Agency for Research on Cancer(IARC) has assigned this to Group 3-"the chemical cannot be classified as to its carcinogenicity to humans."
e-Estimated value,concentration less than specified detection limit but greater than zero.
f-Duplicate analysis is not within control limits.
g-ADI derived from chronic drinking water critreia of 0.62 mg/L x 2L/day= 1.2 mg/day.
h-ADI derived from maximum contaminant limit of 0.05 mg/L x 2L/day= 0.1mg/day.

APPENDIX E TABLE 6
ECC SEDIMENT CONTAMINATION AND EXPOSURE VIA INGESTION AT 003

	Potency ,(mg/kg-day)-1	Maximum Observed Conc. ug/kg	Cancer Risk Residential 0.013 g of sed /kg-day	Worker 0.00013 g of sed /kg-day	Acceptable Daily Intake(ADI) ug/day	Intake in ug/day at Max. Conc. at ingestion of 10.00 g/day	1.00 g/day	0.10 g/day
Carcinogens								
Organics								
Volatiles								
Methylene Chloride a	6.30E-04	6	4.9E-11	4.9E-13				
TOTAL			4.9E-11	4.9E-13				
Noncarcinogens								
Inorganics								
Mercury		1180			.20	12	1.2	0.12
Cyanide		20000			7600	200	20.0	2.00

a-The International Agency for Research on Cancer(IARC) has assigned this to Group 3-"the chemical cannot be classified as to its carcinogenicty to humans."

APPENDIX E TABLE 7
ECC SEDIMENT CONTAMINATION AND EXPOSURE VIA INGESTION AT 004

	Potency (mg/kg-day)-1	Maximum Observed Conc. ug/kg		Cancer Risk Residential 0.013 g of sed /kg-day	Cancer Risk Worker 0.00013 g of sed /kg-day	Acceptable Daily Intake(ADI) ug/day		Intake in ug/day at Max. Conc. at ingestion of 10.00 g/day	1.00 g/day	0.10 g/day
Carcinogens										
Organics										
Volatiles										
Methylene Chloride a	6.30E-04	3	b	2.0E-11	2.0E-13					
TOTAL				2.0E-11	2.0E-13					
Noncarcinogens										
Inorganics										
Mercury		20				20		0	.0	.00
Lead		15500				100	c	155	15.5	1.55
Cyanide		196000				7600		1960	196.0	19.60

a-The International Agency for Research on Cancer(IARC) has assigned this to Group 3-"the chemical cannot be classified as to its carcinogenicity to humans."
b-Estimated value,concentration less than specified detection limit but greater than zero.
c-ADI derived from maximum contaminant limit of 0.05 mg/L x 2L/day = 0.1 mg/day.

APPENDIX E TABLE 8
ECC SEDIMENT CONTAMINATION AND EXPOSURE VIA INGESTION AT 005

	Potency , (mg/kg-day)-1	Maximum Observed Conc. ug/kg	Cancer Risk Residential 0.013 g of sed /kg-day	Worker 0.00013 g of sed /kg-day	Acceptable Daily Intake(ADI) ug/day	Intake in ug/day at Max. Conc. at ingestion of 10.00 g/day	1.00 g/day	0.10 g/day
Carcinogens								
Organics								
Volatiles								
Methylene Chloride a	6.30E-04	9	7.4E-11	7.4E-13				
TOTAL			7.4E-11	7.4E-13				
Noncarcinogens								
Organics								
Base/Neutrals								
Bis(2-ethylhexyl)Phthlate		912			42000	9	0.9	0.09
Inorganics								
Mercury		20			20	0	.0	.00
Lead		4200			100 b	42	4.2	0.42
Cyanide		32000			7600	320	32.0	3.20

a-The International Agency for Research on Cancer(IARC) has assigned this to Group 3-"the chemical cannot be classified as to its carcinogenicity to humans."
b-ADI derived from maxmium contaminant limit of 0.05 mg/L x 2 L/day = 0.1 mg/day.

Table E-9
COMPOUNDS FOUND IN THE GROUNDWATER AT ECC

Volatile Organics

Benzene[b,c] (C)
1,1,1 Trichloroethane
1,1 Dichloroethane[b,e]
Chloroethane
Chloroform[c]
1,1 Dichloroethene (C)
Trans 1,2 Dichloroethene
Trans 1,3 Dichloropropene[b,e]
Ethylbenzene[b,c]
Methylene chloride[d] (C)
Tetrachloroethene[a,c] (C)
Toluene[b,c]
Trichloroethene (C)
Vinyl chloride[b,e] (C)
Acetone[d]
2-Butanone[a,d]
Total Xylene

Base/Neutrals

Fluoranthene[e,c,b]
Isophorone[e,c,b]
Bis(2-ethylhexyl)phthalate[e,c,b]
Diethyl phthalate[e,c,b]
Chyrsene[e,c,b]
Pyrene[e,b]

Inorganics

Aluminum
Arsenic[e,b] (C)
Barium
Calcium[b]
Chromium
Cobalt[e,b]
Copper[b]
Iron
Lead[b]
Magnesium
Manganese
Mercury[b,d]
Nickel
Potassium
Selenium[e,b]
Silver[e,b]
Sodium[b]
Thallium[e,b,d]
Zinc[b,a]
Antimony[a,e,b]

C = Carcinogen

[a] Found only in upgradient concentration
[b] Found only in wells that can not be definitely associated with ECC.
[c] Found at less than quantification limit.
[d] Values may reflect field/lab contamination.
[e] Found in only one well.

GLT424/139

- Well 1A and 2A represent background.
- Well 11A represents the shallow saturated zone.
- Well 8A, 9A, and 10A represent the shallow sand and gravel aquifer under the site.
- Well 7A cannot be conclusively associated with the ECC site. The evidence is insufficient to distinguish between the effect on the groundwater at that point of ECC and the adjacent Northside Landfill.
- Well 3A similarly to 7A could be under the influence of either of the two sites. Additionally, the concentration of chemicals found at that well, given projected groundwater flow rates from the ECC site are most likely due to a localized spill situation. Observation at the site as well as conversation with site owner seems to support this.

Ingestion

A major route of exposure would be ingestion of contaminated groundwater. Tables E-10 through E-11 present the health risk associated with ingestion of contaminated groundwater. The current risks associated with ingestion of the shallow saturated zone as represented by well 11A are presented in Table E-10. The risk from the use of the shallow sand and gravel aquifer is presented in Table E-10. The lifetime excess cancer risk from ingestion is due to 1,1 dichloroethene, tetrachloroethene, and trichloroethene.

Table E-11 presents the risk if concentrations in the shallow saturated zone increase as contaminants are leached out of the soil and into the water table. The maximum values used are based on soil concentrations in the area of test pit 6. The average values are derived from soil values averaged across the entire site. These concentrations should be achieved rather soon, perhaps 5 to 10 years. While the rate of movement of the contaminants into the groundwater would not be the same, for the purpose of this risk assessment, they are treated as if they would discharge into the groundwater at the same rate. Given the slow velocity at which the groundwater moves in this area the concentration in the groundwater would remain essentially constant over 70 years.

Table E-10

ECC-INGESTION OF GROUNDWATER-EXCESS LIFETIME CANCER RISK AND COMPARISON TO ACCEPTABLE DAILY INTAKE-CURRENT CONCENTRATIONS

Ingestion of Shallow Sand and Gravel Aquifer

Compound	Cancer Potency (kg-day/mg)	Maximum Concentration ug/L	Excess Lifetime Cancer Risk: Residential based on 0.035 L/kg/day	Excess Lifetime Cancer Risk: Occupational based on 0.00082 L/kg/day	Acceptable Daily Intake ug/day	Intake ug/day
CARCINOGENS						
1,1-Dichloroethene[a]	0.147	8	4E-05	6E-06		
Methylene chloride[a,b]	0.00063	64	1E-06	2E-07		
Tetrachloroethene[a]	0.035	9[c]	1E-05	2E-06		
Trichloroethene[a]	0.019	21	1E-05	2E-06		
Total			7E-05	1E-05		
Toxicants						
Antimony		4			290	8
Chromium	[d]	13			175	26
Nickel	[d]	46			1,500	92
Methylene chloride		64			13,000	128
Trichloroethene		21			1,700	42

Ingestion of Shallow Saturated Zone

Compound	Cancer Potency (kg-day/mg)	Maximum Concentration ug/L	Excess Lifetime Cancer Risk: Residential based on 0.035 L/kg/day	Excess Lifetime Cancer Risk: Occupational based on 0.00082 L/kg/day	Acceptable Daily Intake ug/day	Intake ug/day
Carcinogens						
Trichloroethene[a]	0.019	28,000	2E-02	3E-03		
Total			2E-02	3E-03		
Toxicants						
Trichloroethene		28,000			1,700	56,00

[a] The International Agency for Research on Cancer (IARC) has assigned this to Group 3 - "the chemical cannot be classified as to its carcinogenicity to humans."

[b] Analyte found in labroatory blanks as well as sample indicates probable contamination.

[c] Concentration less than quantification limit but greater than zero.

[d] Compound has been demonstrated to be carcinogens but not by the ingestion route.

Table E-11

ECC - INGESTION OF GROUNDWATER-EXCESS LIFETIME CANCER RISK AND
COMPARISON TO ACCEPTANCE DAILY-PROJECTED CONDITIONS
SHALLOW SATURATED ZONE

Compound	Cancer Potency (mg/kg-day)	Maximum Concentration ug/l	Average Concentration ug/l	Residential Based on 0.035 L/kg-day Maximum	Residential Based on 0.035 L/kg-day Minimum	Occupational Based on 0.00082 L/kg-day Maximum	Occupational Based on 0.00082 L/kg-day Minimum	Acceptable Daily Intake ug/day	Intake ug/day Maximum	Intake ug/day Average
Carcinogens										
Chloroform	0.070	10,000	400	2×10^{-2}	1×10^{-3}	4×10^{-4}	2×10^{-5}			
Methylene chloride[a]	0.00063	7,000,000	200,000	2×10^{-1}	4×10^{-3}	4×10^{-3}	8×10^{-5}			
1,1,2-trichloroethane[a]	0.0573	2,000	50	4×10^{-3}	1×10^{-3}	8×10^{-5}	2×10^{-6}			
Trichloroethene[a]	0.019	600,000	200,000	4×10^{-1}	1×10^{-1}	1×10^{-2}	4×10^{-3}			
Tetrachloroethene[a]	0.035	100,000	8,000	1×10^{-1}	1×10^{-2}	2×10^{-3}	2×10^{-4}			
PCB (Total)	4.34	150	50	2×10^{-2}	8×10^{-3}	4×10^{-4}	2×10^{-4}			
Total				8×10^{-1}	1×10^{-1}	2×10^{-2}	5×10^{-3}			
Toxicants										
1,1,1-trichloroethane		1,100,000	40,250					38,000	2,200,000	80,500
Toluene		133,750	28,250					30,000	267,500	56,500
Ethylbenzene		38,000	5,500					9,500	76,000	11,000
Phenol		3,950,000	76,250					7,000	7,900,000	152,500
Trichloroethene		275,000	100,000					1,700	550,000	200,000
Methylene chloride		3,500,000	101,250					13,000	7,000,000	202,500

[a]The International Agency for Research on Cancer (IARC) has assigned this to Group 3 - "the chemical cannot be classified as to its carcinogenicity to humans."

GLT424/143

Dermal Absorption

The dermal absorption of contaminants from groundwater would occur during bathing or showering. Table E-12 presents the dermal absorption risks.

SURFACE WATER

Assessment of wading is restricted to the residential setting and volatile organic compounds. Table E-13 presents the excess lifetime cancer risk for wading in Finley Creek based on concentration found from the sampling at SW004. Table E-14 presents the projected excess lifetime cancer risks. The risks are based on projected average release from the groundwater, estimated dilution in the unnamed ditch, and minimum dilutions in Finley and Eagle Creeks.

Ingestion Via Fish Consumption

A risk for consumption of fish caught from the waterways may be estimated. To do so requires the following:

- Assume that fish bioconcentrate the contaminants at rates consistent with the literature
- Fish do not avoid or are especially attracted to areas of contamination
- Contaminated fish are not more easily caught
- Sole source of contaminants in fish is via bioconcentration from water. There is no consumption of contaminated sediment or food chain effects
- Bioconcentration rate is independent of fish species caught
- All of the fish consumed over a 20-year lifetime come from the same waterway
- Bioconcentration occurs in the edible portion of the fish (i.e., the fillets)

These estimates and assumptions produce a conservative risk value. The actual risk would be lower. The scenario proposed here is useful, however, in gaining an estimate of the range of risk that could exist. The results are presented in Table E-15 and Table E-16.

It is not practical to quantify the risk associated with this exposure route. Only the qualitative statement that exposure could increase risk can be made.

GLT360/52

Table E-12
EXCESS LIFETIME CANCER RISK - DERMAL ABSORPTION -
ECC GROUNDWATER

Compounds	Cancer Potency (kg-day/mg)	Concentration ug/l	Excess Lifetime Cancer Risk Residential based on 0.037 L/kg/day
Dermal Absorption of Shallow Sand and Gravel Aquifer - Current Maximum Concentrations			
1,1-Dichloroethene[a]	0.147	8	4×10^{-5}
Methylene chloride[a]	0.00063	64	1×10^{-6}
Tetrachloroethene[a]	0.035	9	1×10^{-5}
Trichloroethene[a]	0.019	21	7×10^{-5}
Total			7×10^{-5}
Dermal Absorption of Shallow Saturated Zone - Current Maximum Concentrations			
Trichloroethene[a]	0.019	28,000	2×10^{-2}
Total			2×10^{-2}
Dermal Absorption of Shallow Saturated Zone - Projected Maximum Concentrations			
Methylene chloride[a]	0.00063	7,000,000	2×10^{-1}
Tetrachloroethene[a]	0.035	100,000	1×10^{-1}
Trichloroethene[a]	0.019	600,000	4×10^{-1}
Chloroform	0.070	10,000	2×10^{-2}
1,1,2-trichloroethane	0.0573	2,000	4×10^{-3}
Total			7×10^{-1}
Dermal Absorption of Shallow Saturated Zone - Projected Average Concentrations			
Methylene chloride[a]	0.00063	200,000	4×10^{-3}
Tetrachloroethene[a]	0.035	8,000	1×10^{-2}
Trichloroethene[a]	0.019	200,000	1×10^{-2}
Chloroform	0.070	400	1×10^{-3}
1,1,2-trichloroethane	0.0573	50	1×10^{-3}
Total			3×10^{-2}

[a]The International Agency for Research on Cancer (IARC) has assigned this to Group 3 - "the chemical can not be classified as to it carcinogenicity.

Table E-13
EXCESS LIFETIME CANCER RISK WADING IN FINLEY CREEK
CURRENT CONCENTRATION[a]

Compound	Cancer Potency $(mg/kg/day)^{-1}$	Concentration ug/L	Excess Lifetime Cancer Risk
Methylene Chloride	0.00063	5	1×10^{-9}
Tetrachloroethene	0.035	5	6×10^{-8}
Trichloroethene	0.019	67	4×10^{-7}
			5×10^{-7}

[a]Based on 0.00034 L/kg/dy intake.

GLT533/12

Table E-14
EXCESS LIFETIME CANCER RISK-WADING-PROJECTED CONDITIONS

Compound	Cancer Potency $(mg/kg/day)^{-1}$	Unnamed Ditch[a] Concentration ug/l	Unnamed Ditch[a] Excess Lifetime Cancer Risk	Finley Creek Concentration ug/l Maximum	Finley Creek Excess Lifetime Cancer Risk Maximum
Trichloroethene	0.019	400	1×10^{-6}	100	6×10^{-7}
Chloroform	0.070	0.6	6×10^{-9}	0.2	7×10^{-9}
Tetrachloroethene	0.035	10	8×10^{-8}	6	8×10^{-8}
1,1,2-TCA	0.0573	0.08	8×10^{-10}	0.03	6×10^{-10}
Methylene Chloride	0.00063	300	4×10^{-8}	100	2×10^{-8}
TOTAL			1×10^{-6}		7×10^{-7}

[a]Based on 0.00016 L/kg/day intake.
[b]Based on 0.00034 L/kg/day intake.

GLT533/13

Table E-15
EXCESS LIFETIME CANCER RISK FROM FISH INGESTION - PROJECTED CONCENTRATIONS

			Unnamed Ditch		Finley Creek				Eagle Creek	
					Concentration ug/l		Excess Lifetime Cancer Risk[b]			
Compound	BCF[a]	Cancer Potency $(mg/kg/day)^{-1}$	Concentration ug/l	Excess Lifetime Cancer Risk[b]	Max	Min	Max	Min	Maximum Concentration ug/l	Excess Lifetime Cancer Risk[b] Maximum
Trichloroethene	10.6	0.019	300	6×10^{-6}	100	10	2×10^{-6}	2×10^{-7}	2.5	4×10^{-8}
Chloroform	3.75	0.070	0.6	1×10^{-8}	0.2	0.02	5×10^{-9}	5×10^{-10}	0.005	1×10^{-10}
Tetrachloroethene	30.6	0.035	10	1×10^{-6}	6	0.6	6×10^{-7}	7×10^{-8}	0.14	1×10^{-8}
Methylene chloride	5	0.00063	300	1×10^{-7}	100	10	2×10^{-8}	2×10^{-10}	2.5	7×10^{-10}
1,1,2-trichloroethane	4.54	0.0573	0.08	2×10^{-9}	.03	.003	6×10^{-10}	6×10^{-10}	0.0007	1×10^{-11}
Total				6×10^{-6}			3×10^{-6}	3×10^{-7}		5×10^{-8}

[a]From ambient water quality criteria.
[b]Based on ingestion rate of 0.088 g-fish/kg-body weight/day.

NOTE: BCF = Bioconcentration Factor

GLT424/140

Table E-16
EXCESS LIFETIME CANCER RISK FROM FISH INGESTION - FINLEY CREEK - CURRENT CONCENTRATIONS

Compound	Bio-concentration Factor[a]	Cancer Potency (mg/kg /day)	Concentration ug/L	Excess Lifetime Cancer Risk[c]
Trichloroethene	10.6	0.019	67	$1x10^{-6}$
Tetrachlorothene	30.6	0.035	<5	$5x10^{-7}$
Vinyl Chloride[b]	1.17	0.0175	10	$2x10^{-8}$
Total				$1x10^{-6}$

[a] From ambient water quality criteria.
[b] Carcinogens effects from inhalation.
[c] Based on ingestion rate of 0.088 g/kg/day.

GLT424/138